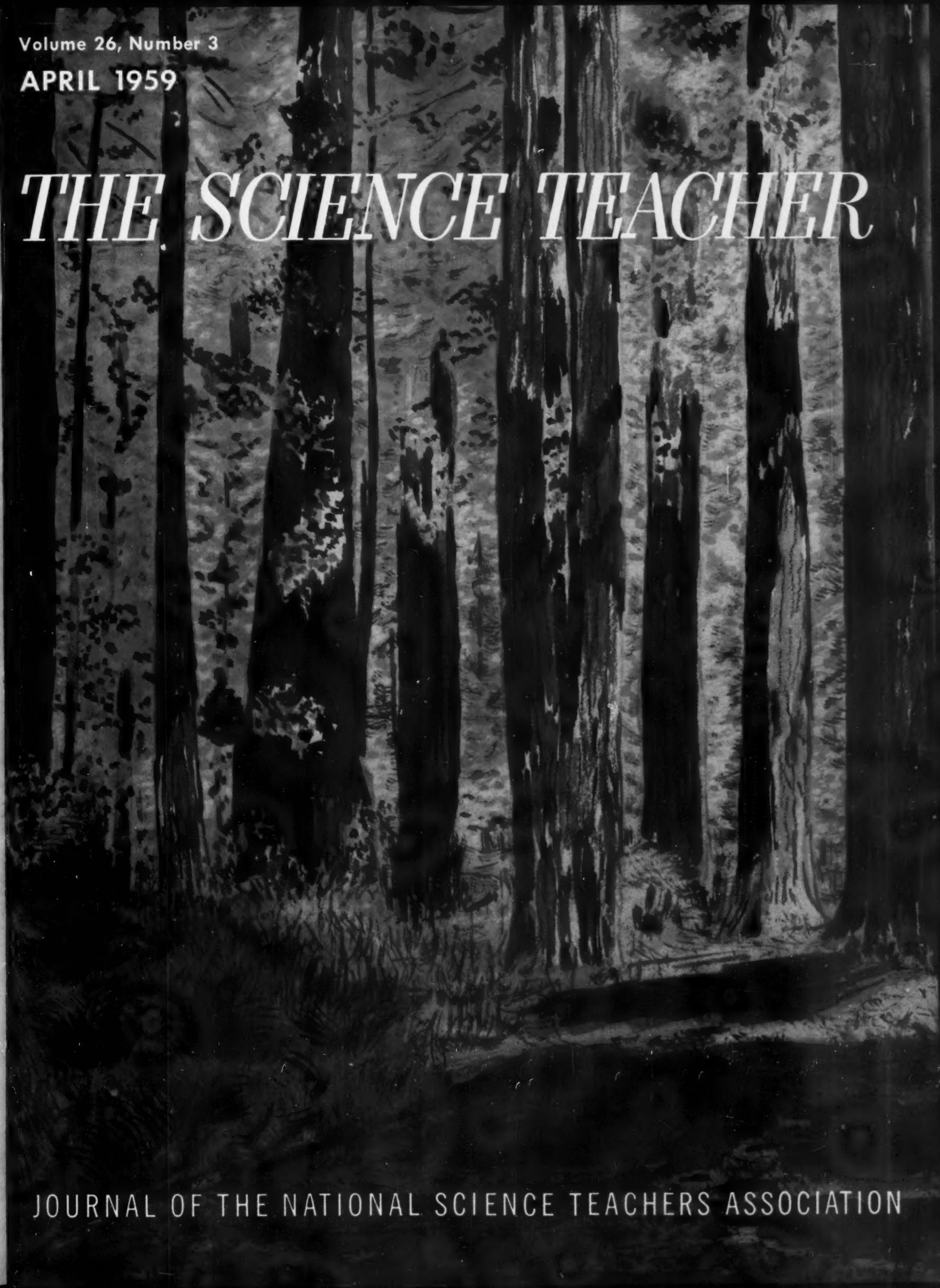
Volume 26, Number 3
APRIL 1959

THE SCIENCE TEACHER

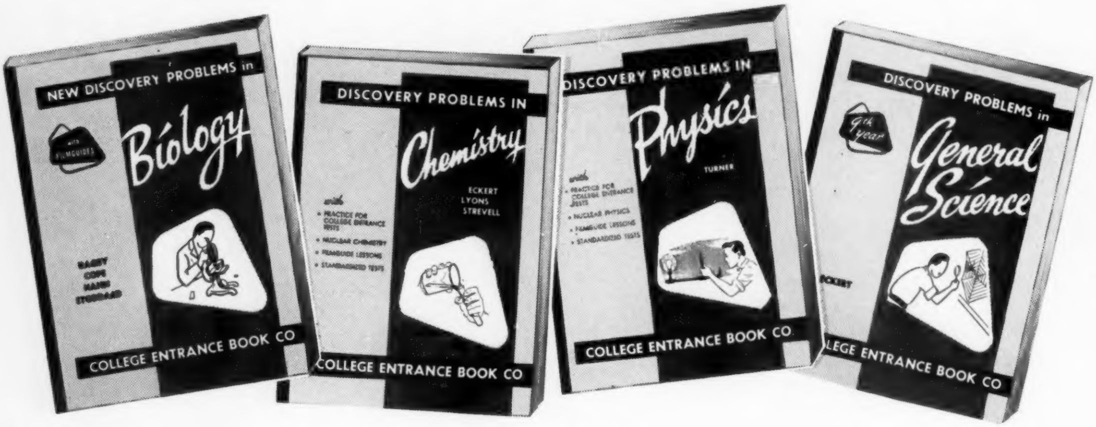


JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

Now Being Used in Over 4,000 Schools . . .

DISCOVERY PROBLEMS WORKBOOKS

for use with any text



YES . . . thousands of teachers, principals, and school boards *choose to use* Discovery Problems workbooks every year. They know, from their own experience, how much these study guides contribute to effective science teaching.

See for yourself how these teaching tools can meet *your* needs in the classroom and in the laboratory. Write, today, for a free sample in the subject you teach, and let the book speak for itself.

COLLEGE ENTRANCE BOOK CO.

104 FIFTH AVENUE • NEW YORK 11

SWIFT

ANNOUNCES

NEW BROADFIELD TEACHING MICROSCOPE - APPROXIMATELY 50% MORE VIEWING AREA

SWIFT BROADFIELD MICROSCOPE

ORDINARY MICROSCOPE

15 WAYS BETTER!

- Research type coated optics
- Professional standard size stand
- Standard quality coarse and fine adjustment
- New type prefocusing gauge and rack stop
- Excellent balance of stand
- Built-in condenser N.A. 0.65
- Disc diaphragm marked for aperture opening
- Color coded Objectives for easy selection
- Deluxe attachable illuminator available
- Stand inclinable to 90°
- Quality mechanical stages available at moderate cost
- Eyepiece locked for safety, removable for cleaning
- Longer working distance on 4mm Objective, better N.A. 0.65
- All metal construction, superior finish
- Extra large stage 115mm x 140mm

ONLY **10080** each, in lots of 5

IN NEW, MODERN SAND FINISH

112.00 each, on single order

Deluxe attachable illuminator available, in place of mirror, at $6.30 each additional in lots of 5, or $7 each on single order.

SPECIFICATIONS: SWIFT High School Broadfield Teaching Microscope, model SST-3. Standard in size, professional in construction. Triple revolving nosepiece with achromatic coated Objectives 4x or 30mm, N.A. 0.10; 10x or 16mm, N.A. 0.25; 40x or 4mm, N.A. 0.65. Objectives parfocal; color coded for ease in selection. Widefield coated Eyepiece 10x locked to body tube, but removable for cleaning. Coarse focusing by standard rack and pinion and lever type fine adjustment. Large stage 115mm x 140mm with metal stage clips and drilled to receive mechanical stages SA or SB. Built-in condenser N.A. 0.65 disc diaphragm, aperture numbered for easy selection of correct opening. Large professional stand is so constructed that the base shoe acts as a bumper guard to protect the stage and optical system from damage. Inclinable to 90°. All gears of brass and machined to precise accuracy. Combination of rack stop and prefocusing gauge to reduce slide breakage and increase rapidity of focusing. Combination plane and concave mirror in fork mount. Complete in shipping case.

SWIFT & ANDERSON, INC.
1572 N. FOURTH STREET • SAN JOSE, CALIFORNIA

Mail Coupon Today FOR FREE DEMONSTRATION

SWIFT & ANDERSON, Inc.
1572 N. Fourth Street, San Jose, California
Without any obligation on my part,

☐ Please send me complete literature.
☐ Please schedule demonstration through authorized Swift dealer.

NAME..
TITLE..
ADDRESS..
CITY........................STATE..........

Improved Welch Cadet Meters and Galvanometers Are Serving The Schools Throughout The Nation

No. 2732 Galvanometer

Large legible scales
permanently printed on metal

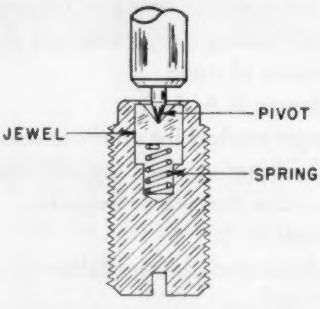
Superbly constructed
with substantial overload factor

Wide choice of Types and ranges
all accurate to within 2% of full scale

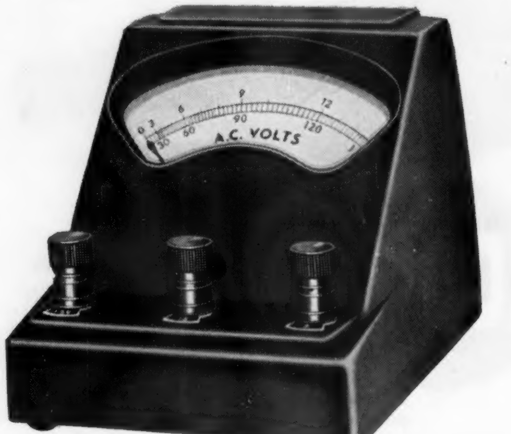
D. C. ranges in black case
A. C. ranges in maroon case

Every Welch Cadet meter is delivered to you in a moisture-proof, dust-tight plastic bag—guaranteed to read correctly.

Cadet Meters were developed by Welch for use by students, and for all other applications where a rugged, low-cost instrument of moderate precision is needed.



Shock-mounted jewel bearing
now standard in all Cadet meters



No. 3081A A.C. Voltmeter

The large easy-to-read scales are permanently lithographed on metal. They will never buckle or become loose. The slanting front of the meter inclines the scale at 45°, permitting it to be read with equal ease from eye level or from directly above, a feature of special value to instructors supervising student work. The scales in all Cadet meters are a full three inches long, substantially longer than those commonly used in panel meters. All binding posts have non-removable heads and are clearly and permanently marked for polarity and range.

Cadet meters are available as galvanometers, voltmeters, millivoltmeters, ammeters and milliammeters, with single or multiple scales in many different ranges, and with either D.C. or A.C. movements. See the Welch catalog for a complete listing.

Write for the Welch Electrical Measuring Instruments Catalog which gives Complete Descriptions and Prices.

W. M. WELCH SCIENTIFIC COMPANY

DIVISION OF W. M. WELCH MANUFACTURING COMPANY

ESTABLISHED 1880

1515 Sedgwick Street, Dept. T, Chicago 10, Illinois, U. S. A.

Manufacturers of Scientific Instruments and Laboratory Apparatus

THE SCIENCE TEACHER

Staff

Editor ROBERT H. CARLETON
Associate Editor and Advertising FRANCES J. LANER
Circulation Manager GLENN E. WARNEKING
Membership and Subscriptions EDITH M. NICHOLAS

Advisory Board

ABRAHAM RASKIN (1959) CHAIRMAN
Hunter College, New York City
ALFRED B. BUTLER (1961)
The State College of Washington, Pullman
ESTHER BOSSUNG (1960)
Public Schools, Louisville, Ky.
JOHN H. MAREAN (1959)
High School, Reno, Nev.
RICHARD SALINGER (1960)
High School, Wilton, Conn.
LOUISE STAKELY (1961)
Public Schools, Atlanta, Ga.

Science Consultants

William Jones Bowen, National Institutes of Health, BIOLOGY
James W. Cole, Jr., University of Virginia CHEMISTRY
John S. Toll, University of Maryland, PHYSICS

The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

Volume 26, Number 3 **April 1959**

Mathematics-Science Seminars
Murl B. Sailsbury ... 150

Elementary Activities in Nuclear Energy
Robert Stollberg and Charles E. Burleson ... 155

Pitfalls in Planning
M. L. Blaustein ... 158

We Added a Classroom
Stephen S. Israel and Herbert D. Thier ... 161

Viewpoint for Modern Science
Sam S. Blanc and George E. Mathes ... 164

Trends Regarding Science Teachers
Lucy Staring, John L. Garrett, Jr., and Sam Adams ... 167

Rebuilding the Science Program
Expansion of High School Chemistry
John T. Stock ... 168
Laboratory Science in the Small College
Lester C. Shell ... 173
Advanced High School Chemistry
John F. Yon and William McIlwaine ... 176

Through the Microscope
Bruce A. Lloyd ... 179

An Incubator from an Old Refrigerator Cabinet
Theodore J. Ammel, Jr., and Clarence W. Rice ... 182

Spotlight on Research
Use of Science Teaching Demonstrations
Edith M. Selberg ... 186

Time-Lapse Photography
John B. Reed ... 195

Science Teaching Materials
Book Briefs ... 205
Professional Reading ... 206
Apparatus and Equipment ... 206
Audio-Visual Aids ... 206

Editor's Column ... 148

Readers' Column ... 149

NSTA Activities ... 201

FSA Activities ... 203

Index of Advertisers ... 208

Editor's Column

Each time we announce another Bell System TV science program and request reactions, the response is heavy and ranges from one end of the pH scale to the other. "The Alphabet Conspiracy" has produced an unusually heavy and vociferous influx of mail.

From Florida a member wrote: "I'm amazed that a combination of what ought to be the best in the field of science and the best in the field of visual production should end up with such a hodge-podge of soft-soap entertainment. Do you know what attempts have been made to evaluate this program and what criteria have been used? All my experience in teaching leads me to reject this kind of approach to science education."

An Illinois member said: "I thought I would see an interesting and reasonably accurate program discussing the origin and relationships of written (and perhaps spoken) languages. I was shocked at the relentless drivel that appeared on the TV set. I could have put on a better program with colored chalk, a blackboard, and 20 minutes preparation. To have NSTA in any way associated with such a pitiful endeavor is insulting to the mentality of its members or their students."

But then from Iowa: "We have enjoyed and profited from the Bell System science series. I am highly in favor of any and all such educational programs."

Balancing out the viewpoints expressed in perhaps 600 such letters is the Bell System's problem. As far as NSTA is concerned,

—we have been glad to cooperate by announcing the TV showing dates for all films in the series;

—we have arranged for "previews" of the films by teachers, supervisors, and other appropriate persons in the D.C. area;

—we recognize that TV showing to mass audiences is the primary purpose of the films and that possible school use is a secondary consideration; also, we have pointed out that under these circumstances school use comes out a poor second;

—we have discussed in a preliminary way the possibility of a thorough evaluation by NSTA of the school use of the films.

Your letters of comment and advice are most helpful. Be assured they are appreciated by those in charge of the educational services program of AT and T. If what you suggest for improvements doesn't show through in succeeding films, however, I'd guess it's because the wheels turn slowly—TV and film producers have some pretty firm notions of how to do things. If teachers accept and use the films as they are, these notions will be supported, at least by inference. On the other hand, you can reject the offerings. If you do so and if you let your reasons be known, then you will be speaking a language that will be understood. Incidentally, the need for more discriminating criticism of the offerings of commercial TV is well defined in the March 14 issue of *Saturday Review* (p. 56).

Robert H. Carleton

THE SCIENCE TEACHER

The Journal of the National Science Teachers Association, published by the Association monthly except January, June, July, and August. Editorial and executive offices, 1201 Sixteenth Street, N.W., Washington 6, D. C. Of the membership dues (see listing below) $3 is for the Journal subscription. Single copies, 50¢. Copyright, 1959 by the National Science Teachers Association. Second-class postage paid at Washington, D. C. Printing and typography by Judd & Detweiler, Inc., Washington, D. C.

Articles published in THE SCIENCE TEACHER are the expressions of the writers. They do not represent the policy of the Association or the Magazine Advisory Board.

OFFICERS OF THE ASSOCIATION

Herbert A. Smith, *President*, University of Kansas, Lawrence, Kansas

Donald G. Decker, *President-elect*, Colorado State College, Greeley, Colorado

Glenn O. Blough, *Retiring President*, University of Maryland, College Park, Maryland

Sylvia Neivert, *Secretary*, Bay Ridge High School, Brooklyn, New York

Robert T. Lagemann, *Treasurer*, Vanderbilt University, Nashville, Tennessee

Robert H. Carleton, *Executive Secretary*, 1201 Sixteenth Street, N. W., Washington 6, D. C.

MEMBERSHIP

The membership year coincides with the calendar year. New entries during the fall months extend through the following calendar year.

Regular Membership	$ 6.00
Sustaining Membership*	10.00
Student (college and university) Membership	2.00
Life Membership* Payable in ten annual installments; $150.00 if paid in three years or less.	175.00
Library Subscription*	8.00

*** Includes the *Elementary School Science Bulletin* and *Tomorrow's Scientists*.**

Readers' Column

Following is Dr. Phillips' reply to Dr. Horn's letter (See *March TST*) on the article, "Aberrations in Discussions of Newton's Laws," which appeared in the December *TST*. *Editor.*

I agree with Dr. Horn—and I think most textbook authors do, too—in depending on the student's intuitive understanding of certain fundamental concepts such as those of *length* and *time*. The concept of *mass*, however, cannot be handled quite so simply, probably because the word is already familiar to students in too many other contexts. For this reason, textbooks usually introduce the idea via a description (or a reminder) of experiences which illustrate the tendency or the property that a material body has to "resist attempts to change its state of motion," and in these descriptions very often use the word *inertia* as the name of the property. What I was trying to say was just this: Let's not now try to define mass as something that *depends on* the inertia; let's treat the word *mass* as a *synonym* for the word *inertia*. This is not a "circular definition"; it is essentially putting *mass* in the same category as *length* and *time*—as a basic concept which we do not try to define in terms of something more fundamental. One must remember, however, that defining a concept and defining a unit in terms of which that concept is to be measured are two different things.

While it is not said directly, Dr. Horn's letter seems to imply that he considers *mass* and *matter* to be synonymous. They are not; mass is merely *one* of the properties of matter.

And may I correct one of Dr. Horn's statements? I do not object to defining mass as "quantity of matter" because it leads into the blind alley of defining *matter*, but because it leads into the blind alley of defining *quantity* of matter. These, also, are two different things.

L. W. Phillips
University of Buffalo
Buffalo, New York

Ninth-Grade Biology

Concerning the article on page 454 of the December TST issue, I am dismayed that a man with Mr. Goldstein's credentials would draw the conclusions he did from the evidence he had on the problem he was trying to solve! The problem he was trying to solve concerned the possibility of strengthening the *over-all* four-year science training of selected students. The conclusions he makes concern the relative standings on a standard test of his ninth- and tenth-grade students. The problem has changed in mid-stream!

While it is true that his evidence indicates that his ninth-grade students did not do as well as his tenth-grade students on the regents exam in biology, this in no way indicates that the original purpose of the curriculum change was not being fulfilled. He cannot answer his original problem until his biology students of the ninth grade have completed their senior year, and even then he cannot have an answer unless he tests that group against the remainder of that same class, the fraction that did not have biology in the ninth grade. *His* conclusions would seem to indicate that the curriculum change was designed to strengthen the *biology* training of his students, not their *over-all* science training.

One or two other things bother me concerning his study. He does not hazard a guess as to what effect the extra year of study in general science had on the performance of the tenth-grade students. The extra year does not seem irrelevant to me. Further, he writes as though he were trying to train a generation of biologists and is dismayed that they did not "master" the material; Mr. Goldstein, be of good cheer! I have not mastered the material, you have not mastered the material, and your tenth-grade students have not mastered biology. And they won't in one year, or ten, either. Therefore, let us not feel that there is a certain volume, a certain mass, of material they should "master." Let us rather look at

(Continued on page 207)

LABORATORY MANUALS AND WORKBOOKS

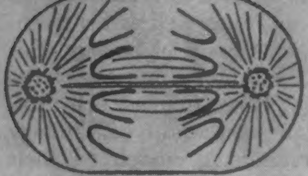
Adaptable with any basic text to meet all your laboratory needs.

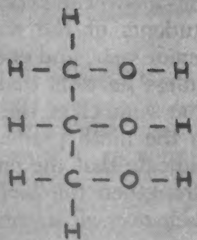
- ☐ BIOLOGY LABORATORY NOTEBOOK
- ☐ CHEMISTRY LABORATORY MANUAL AND WORKBOOK—SEMI-MICRO METHODS
- ☐ CHEMISTRY LABORATORY NOTEBOOK
- ☐ GENERAL SCIENCE LABORATORY SHEETS
- ☐ PHYSICS EXPERIMENT SHEETS
- ☐ PHYSICS LABORATORY NOTEBOOK (Revised)
- ☐ PHYSIOGRAPHY LABORATORY SHEETS (Revised)

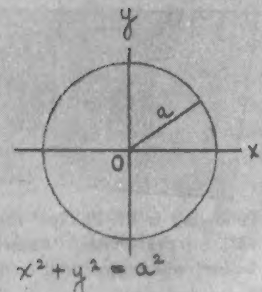
Kindly check the manuals you would like to examine with a view toward adoption. One manual will be sent complimentary; others requested will be sent on approval.

GLOBE BOOK COMPANY

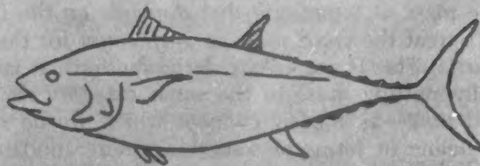
175 FIFTH AVENUE NEW YORK 10, N. Y.

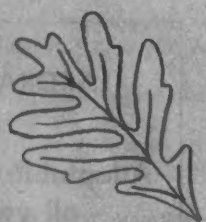




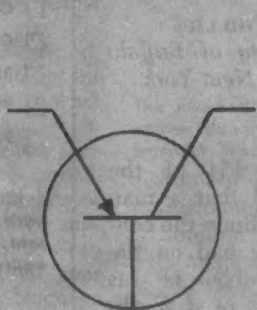


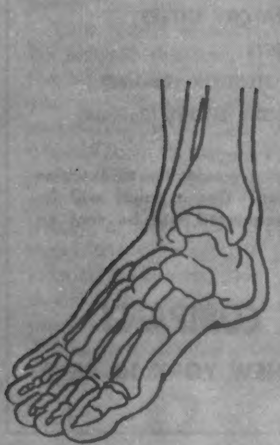
MATHEMATICS-SCIENCE SEMINARS





for talented secondary school students





By MURL B. SAILSBURY

Evanston Township High School, Evanston, Illinois

USUAL approaches to the education of talented mathematics-science students are represented by our Seminars at Evanston Township High School. Few restrictions, except such practical ones as time, availability of equipment, and the students' own abilities limit the nature or the extent to which their members may carry on independent and group studies and experimental work. This paper presents the basic principles and history of developing the Seminars.

The Seminars evolved over an eight-to ten-year period from extensive work with members of our Math-Science club. Membership runs from thirty-five to fifty and consists of a select group of students with appreciable abilities and interests in mathematics and science. From the beginning (of the sponsorship of the club), emphasis was placed on dealing with non-high school aspects of these two areas and on advanced level project work. Participation was entirely by student members. Over a period of about eight years, two significant advances were made. A considerable quantity of advanced non-high school information had been acquired through student presentations. Secondly, the group was led to acquire status through news releases and programs relative to their achievements as a group and as individuals. This acquired status permitted members to do unusual and advanced studies and research project work without concern about negative comments by others.

This report was an entry in the 1957-58 STAR (Science Teacher Achievement Recognition) awards program conducted by NSTA and sponsored by the National Cancer Institute, U. S. Public Health Service.

Sometime during the fall of 1950 the superintendent suggested that school time be taken to initiate this program, that it have a name, and that course credit be given. It became the *Science Seminar*. The name has since been modified to *Mathematics-Science Seminar* out of recognition of the emphasis on mathematics and of the significant contributions which staff members of the mathematics department make.

The Seminars operated from the beginning without assignments, homework, tests, or grades. These are common complaints of students and have been the traditional methods for motivating and promoting learning. Members are assured a satisfactory grade providing they participate in

Informal Seminar sessions, students and author (right).

Seminar activities and prepare a project paper. A check mark is entered in the school records each period to indicate continued membership, and a grade at the end of each semester.

Our school operates on an alternating A-B day schedule. Such courses as laboratory sciences have one period recitations, followed the next day by double period laboratory work throughout the school year. For example: in a two-week period each class has five recitations and also five laboratory sessions. There is a free period available on recitation days. This free period is used for the Seminars. Since Seminar is every other day, one half unit of credit is given for the year's work.

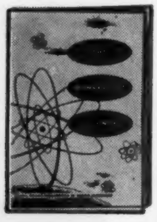
Our eleventh grade (junior) science courses are chemistry and physical science honors. The twelfth grade (senior) courses are physics and physical science college level. In order to secure direct benefit from both chemistry and physics, the Seminars begin in the spring semester of the junior year and continue through the fall semester of the senior year.

Three Seminars are currently in operation with a total of forty-four members. Each is limited to about fourteen members. Crowded junior class schedules prevent some from entering. Several members work independently until their senior year and then enter Seminar. Occasionally a student may work independently on a project for entry in various competitions or out of personal interest and enthusiasm.

A permit is required for Seminar. The permit is based upon careful screening; also criteria developed from data kept about former participants are used. Each year a few "experimental" students of doubtful promise according to these criteria are admitted. This is done primarily for three reasons. The screening evaluations admittedly have imperfections. Secondly, some promising students have generalized educational interests and motives which cause them to strive for excellence in course work as such. Many of these students can acquire a strong interest in mathematics and/or science and in creativeness in these areas within a year's time. Some students have not made even tentative career choices by their junior year.

Selecting Criteria

Six criteria have been evolved in an attempt to identify talented mathematics-science students and to serve also as the bases for the granting of Seminar permits. The single best clue to such students is consistently high grades in all of their academic courses. Some modifications of this statement will be made. High grades at least indicate capacity for intellectual achievement. Top national contest winners are inevitably near or at the top of their graduating classes. It is strongly suspected that this is a built-in criterion which handicaps some mathematics-science students—as the youngster who is gifted (?), or motivated (?), to an astonishing degree almost exclusively in these fields. (They similarly exist in other areas.) Characteristically, they neglect many other endeavors. Many of these cannot conform to the generalized "rounding" emphasis current in education today and are lost in the process. An unqualified criterion of grades would also exclude the youngsters with latent abilities and the ones showing consistent or spotty improvement through their school careers. Particular attention must be paid to transfer students for they may go unnoticed or be evaluated incorrectly because of differences in grading systems. This situation was solved by arranging with the registrar to identify the accomplished transfer students at the very beginning.



Your SCIENCE CLASSES spring into NEW LIFE

Is your Science teaching geared to the vastly growing importance of Science in our daily lives? Do your pupils look forward to each class in the subject?

They will when you use the four new SCIENCE REVIEW-WORKBOOKS titled:

BOOK I SCIENCE FRIENDS ABOUT US
BOOK II THE MARVELS OF SCIENCE
BOOK III EXPLORING WITH THE SCIENTIST
BOOK IV SCIENCE CHANGES OUR WORLD

Each is complete, one for each of the grades fifth through eighth, and each follows the Warp Five-Point Method of fact fixing; modern education's greatest teaching technique.

And they are so economical to buy. Only 45 cents a copy when you buy 100 or more. So count your Science pupils in the four grades, order your SCIENCE REVIEW-WORKBOOKS on ten-day free trial.

WRITE FOR FREE CATALOGUE

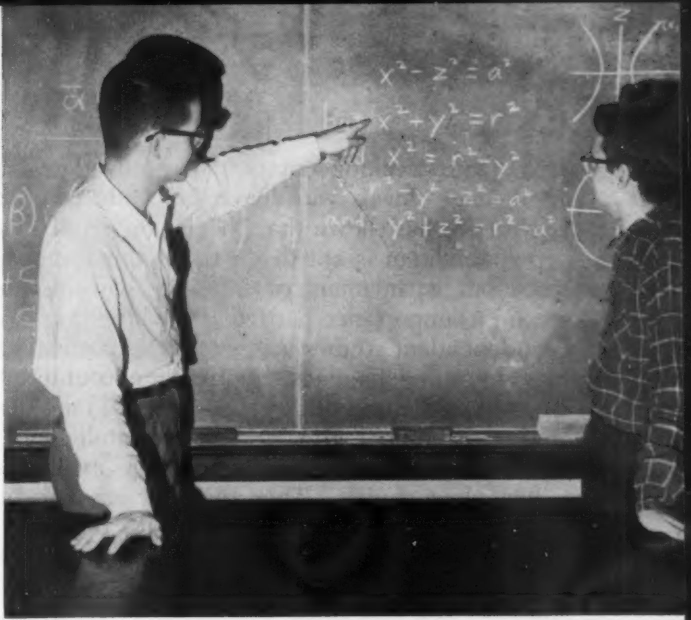
WARP PUBLISHING COMPANY
MINDEN · · · · NEBRASKA

The second best criterion has proved to be a personal history of significant hobbies. These may be material hobbies or individual studies in mathematics and/or science. As a rule of thumb, electric trains, insect collections, building a telescope, "having a microscope," keeping an aquarium, and others have minor significance in this history of juniors and seniors. Such things have usually been done at an earlier age and have been discontinued. There seldom is a sequential development of them and/or a continuum from one to another. It is somewhat analagous to patent work which is discontinued. A continuum of substantial "hobbies" even though unrelated is indicative of evolving creativeness.

Accomplishments such as collecting and classifying fossils to species for five years, a catalogued collection of five hundred mineral specimens, advanced study in aspects of mathematics and/or science are highly significant in identifying the talented student being considered here. Careful investigations of this aspect aid in detecting those students not indicated by, but referred to under criterion one. Such information assists students to find suitable study projects.

Investigations, which have been carried on in relation to this present work with talented students, support the position that originality (except accidental-one time) in human efforts is acquired by a "maturation process." It has its minute beginnings in some first atypically productive effort which may have gone unnoticed, produced a personal feeling of success or accomplishment, solved some immediate situation, received sanction, approval, or recognition from an adult. With repeated similar experiences the capacity for creativeness becomes more pronounced and is related to intelligence only in degree and kind. In some it matures more rapidly, in others slowly. Apparently it is both directed and motivated by personal approval-disapproval; the wholesome, socially desirable creativeness primarily by adults, and the unwholesome, socially disapproved brands by the youngster's peer.

This position was taken after study of many published biographies of creative adults and detailed information from more than five hundred high-ranking students, plus such information regarding most students who have been in the author's regular classes. This hypothesis was checked by examining the early childhood records of some 100 students through interviews with their parents.



Students, Robert Higgins (l.) and Steve Swigert (r.) teach advanced mathematics and science. (Both are among top 40 Westinghouse Talent trip winners of 1959.)

According to the findings, creativeness can be intentionally brought about in students. Originality, to persist, must be rewarded somehow. Its extent and kind seems to be matched with the tolerance permitted innovation by the particular environment of each person. A new innovation in paperwad blow guns receives adult disapproval and peer approval and attention; working algebra or dissecting an insect in grade school almost always secures both adult and peer disapproval; working algebra or doing an insect dissection by a different method in high school frequently secures adult disapproval and is ignored or disapproved by peer.

Historically the rare, creative adult has had to be unusually persistent to reach that state. By wise decisions and sincere approval at appropriate times, creativeness by young people can be encouraged by adults. Learning experiences with the use of small "gimmicks" offer simple beginnings—research always contains numerous minor and major "gimmicks."

This interpretation suggests both an explanation and solution to numerous perplexing students and situations in education and elsewhere.

A typical student behavior, either desirable or undesirable, most usually must function underground. It is unfortunate that socially desirable creativeness cannot operate openly in most classrooms. This is why the criterion of hobbies and independent study assumes such significance. It appears that at present it develops almost entirely outside formal education. To foster it is time-consuming.

The third ranking criterion has proved to be intelligence level (academic aptitude, I.Q.). Experience has shown that, in the context of this paper, this item is not distinctly of third importance but is, in many cases, to be elevated to second in importance particularly where hobbies or independent studies are missing or not extensive in nature. The most frequently encountered talented students (in this paper—top 10%) are the ones with both superior grades and intelligence, but having no extensive hobbies or extensive independent studies. They typically are known as prompt, attentive, sincere, neat, thorough, cooperative, conforming students and are liked by all faculty members. This combination of criterion, one and three, exclusive of two, characteristically reveals a young person who does well whatever is specifically assigned to him, flounders throughout an individual experimental research project (surprisingly so when I first became aware of this), but very frequently turns out significant work on abstract theoretical topics. Examples are: *An Attack on the Four Color Problem, Irregular Solids in N-Dimensional Space, Rapid Systems of Computation Using the Binary System, and Some Mathematical Aspects of Crystallography.*

During the first 16 years covered in this paper no student below I.Q. 130 had progressed well on advanced project work, as considered here, and placed in national competitions. For this and other reasons, the minimum I.Q. for admission to Seminar is 125-135. This holds true unless it is evident that superior ratings on other criteria can make up for the discrepancy. During the past two years several students below this figure have won recognition nationally. The mean and median of the present Seminars are both between I.Q.'s 135-140. The high is 185 and three scores are below 120.

There seems to be a rather definite relationship between intelligence level and the nature of project work which students have undertaken. Relatively short-term experimental ones such as investigating *The Effects of Sodium Ions on Plant Growth and The Designing and Construction of a Solar Furnace* characteristically are done by students up to I.Q. 135. Those of higher ability (I.Q. 135-160) do longer term experimental investigations such as biosyntheses, effects of the gibberellins, and hormone studies. The rarest student of all, some 12 cases (I.Q. 160 up), has almost always shunned experimental situations; but works on highly theoretical problems usually involving advanced mathematics beyond the high school level or even first year college.

To make sure that all potential Seminar students become known, our testing department prepares a personal list of all entering freshmen with intelligence levels above I.Q. 125-135. The names of all transfer students whose test scores are above this point are also furnished.

The fourth criterion is that each Seminar student is expected to have plans to have taken four years of mathematics and three years of science (exclusive of general science). There are exceptions for those unusual students.

The fifth criterion is the student's expressed intent to enter some aspect of mathematics and/or science as an adult career. This is expected of them since it will justify the expenditure of the time and effort required in the Seminar work. It is also a clue as to the degree of significant motivation to be expected. Here again, there are exceptions. Otherwise qualified students each year request to be accepted because they are undecided as to a possible future career. Two out of three such students acquire a strong interest in science, do a fine job, and continue in science in college.

A sixth criterion should be mentioned. Members of the mathematics and science departments (and other departments too), detect and recommend students whom they consider to have unusual ability and interest in our areas.

These students are unusually busy. They carry very heavy class loads and participate extensively in school activities. Among them will be found editors, school club and organization presidents, drama leads, and leaders in church and community youth activities. Some are employed part-time and during summer vacations. They are successful contestants in poetry, literature, writing, language, art, history, speech, science, and other competitions. The resemblance between them as real people, and their cultural stereotype is very remote. "Discipline" is unknown. The working relationships with them are almost identical with those between a director of research and his adult staff.

At least one or two students every year are extreme mathematics-science specialists to the general exclusion of other interest areas except for earning superior grades in all subjects. As is well known, this occurs similarly in sports, journalism, music, and all other areas. A superior grade should indicate superior accomplishments

(Continued on page 191)

elementary activities in NUCLEAR ENERGY

By

ROBERT STOLLBERG and CHARLES E. BURLESON

Professor of Physical Science — Associate Professor of Physical Science

San Francisco State College, California

THOSE who would include concepts of nuclear energy in the education of youngsters have a difficult task. Much as they wish to provide meaningful experiences for students, they find that this area of science provides little in the way of activities that are genuine, safe, and within the scope of typical resources. Here is a set of learning activities practical at intermediate and junior high school levels. The selection is concerned entirely with the detection of nuclear radiation. (Figure 1.)

Radioactive materials have long been known to give off three kinds of radiation. These are referred to by letters of the Greek alphabet as follows:

- (α) alpha particles—actually nuclei of helium atoms.
- (β) beta particles—actually high speed electrons.
- (γ) gamma rays—actually high energy electromagnetic waves—similar to X rays but more penetrating.

In addition, many nuclear reactions give off neutrons. To the extent that students can have real experiences with these phenomena, the aspects of nuclear behavior become more meaningful to them.

Alpha particles are produced by the luminous paint on night-vision clocks and watches. This contains minute quantities of a compound of radium which gives off alpha radiation, among others. The alpha particles strike zinc sulfide, which is also in the paint, and produce visible light. Students can observe this with a magnifying glass in a darkened room. Under moderate magnification they can see countless little flashes reminding them of a tiny, silent sparkler. The resemblance is deceiving, however; in luminous paint the flashes are caused by electrons which have been struck by alpha particles. In a more refined form, this device is sometimes called a *spinthariscope*.

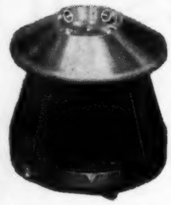
Alpha particles also show their effect in a cloud chamber. The construction of this device, however, requires abilities and materials not usually possessed by pre-adolescents.

Beta particles are not easily detected with simple equipment.

Gamma rays affect photographic film or paper, thus providing a valuable method of detection. To show this, wrap unexposed film or paper—a few square inches will do—securely in black paper. A hand or numeral from an old night-vision alarm clock makes an excellent radiation source; some radioactive minerals work well, too. The source should be placed directly on the

SEMI-MICRO
FOR SCHOOLS

CENTRIFUGE



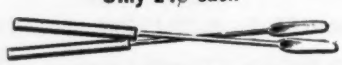
COMPLETELY SAFE for student use.

Interchangeable cast aluminum head holds 10 x 75 mm tubes and 13 x 100 mm tubes.

No waiting—stop Centrifuge with slight palm pressure. Silent, ruggedly built for long life.

No. T 3080 Waco Separator for 110 volt 60 cycle..................$47.00

SPATULAS
Only 24¢ each



HAND FINISHED Spatulas perfectly shaped for semi-micro. Corrosion-resistant monel metal with a red plastic handle. Blade is slightly dished with a round bottom.

No. T 10115—Waco Spatulas, monel, 175 mm long, 23 x 5 mm blade tapered to 3 mm tip.

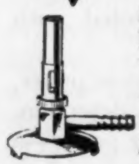
$3.10 per dozen $24.00 per 100

HOT PLATE

A 3" personal hot plate for each student. Priced under three dollars. Made to specifications of Dr. L. F. Fieser for organic semi-micro. Nichrome element and highly conductive aluminum head. Complete with cord set.

No. T 6612—Waco hot plate $2.95

BURNER



Adjustable Natural and Mixed Gases. Both gas and air are adjustable for full control of flame. Nickel-plated brass with flame stabilizer top. Takes 7/16 wing-top, burner height 85 mm.

No. T 2627 Waco Burner....$1.80 each

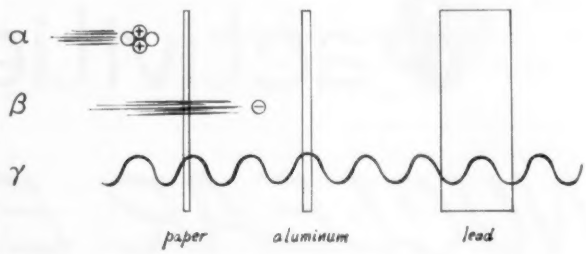
Dozen or more......................$1.60 each

WRITE FOR FREE SEMI-MICRO
Catalog No. T-4

LABORATORY SUPPLIES AND CHEMICALS
WILKENS-ANDERSON CO.
4525 W. DIVISION ST., CHICAGO 51, ILLINOIS

black-wrapped package. Development is by conventional photographic means, even a child's toy darkroom outfit will do. Some teachers obtain X-ray film from a dentist, then return it to him for developing!

The length of exposure varies widely depending on the strength of the source and the sensitivity of the paper or film used. Typical exposures



α alpha—stopped by sheet of paper

β beta—stopped by thin metal or one inch of wood

γ gamma—stopped by several inches of lead or several feet of concrete

⊕ proton ⊖ electron ○ neutron ∿∿ electromagnetic wave

Figure 1

are from several hours to a week or two. The experimenting necessary to determine suitable exposure is a genuine scientific investigation and provides youngsters with a fine opportunity to plan an experiment, to keep records, and to interpret results.

Photography is a valuable research tool in radiation physics. "Film badges" are worn by persons working with radioactive materials; these devices are periodically developed and inspected to see whether or not the wearer has exceeded a safe quantity of radiation.

Gamma rays can also be detected by a Geiger counter. These are often loaned by local fire departments or civilian defense agencies. With a little enterprise, however, it is possible to assemble a simple but functional Geiger counter.

The sketch shows the connections.

power supply: 275-300 volts—*NO MORE!*—use batteries from electronic photoflash gun or from portable radios—consult a high school science teacher or a radio repairman for help. Be careful of shock—it is painful but not hazardous.

Geiger tube:—use Victoreen No. 1B86—obtain from Victoreen Components Division, 3800 Perkins Ave., Cleveland, Ohio, or local electronics parts supplier—cost is about $8.

resistor: 1,000,000 ohms, ¼ watt—rating not critical.

capacitor: 0.0005 micro-farads, 400 volts—rating not critical. Obtain resistor and capacitor from radio repairman—cost of both is about 25 cents.

earphones: use inexpensive single or double earphones, or use the "receiver" from a demonstration telephone circuit.

The Geiger tube has for its negative terminal (cathode) a metal cylinder. Its positive electrode (anode) is a wire down the center of the tube. Ordinarily no current exists between the electrodes. But gamma rays ionize the gas in the tube and current exists for a fraction of a second, producing a click in the earphones. (Figure 2.)

Ordinarily there are 20-25 clicks per minute with no radioactive materials present. This is the "background count," and is due to cosmic rays. The average background count (clicks per minute) must be subtracted from any observed count in interpreting the performance of the Geiger counter. After the instrument is successfully assembled, youngsters can determine the local background count for their tube, and can observe the relative intensity of radiation from watches, minerals, etc. They can also note the effects of shielding by placing measured thicknesses of paper, wood, water, iron, lead, or masonry between the source and the Geiger counter. The effects of distance can be observed by varying the spacing between the source and the counter. (Figure 3.)

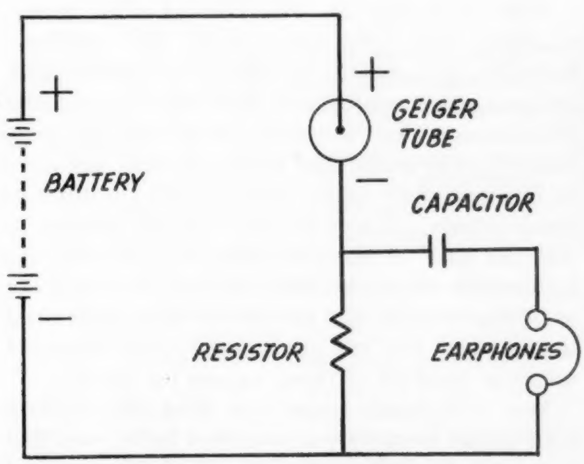


Figure 2. Builder's schematic diagram. An experienced builder knows the meaning of each common symbol. The diagram is thus like an "electronic blue-print" or set of directions for construction.

The performance of this instrument can be made audible to an entire class by removing the earphones and connecting the counter's output terminals to the input of a phonograph amplifier or public address system.

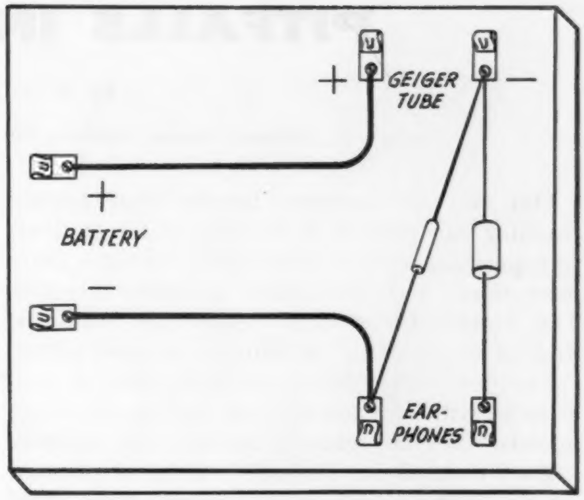


Figure 3. Sketch showing how this circuit might be built on a plaque of wood. Connections to battery, Geiger tube, and earphones are made easy with *Fahnestock clips*, which cost less than 2 cents each. The small cylinder is the resistor, the large cylinder is the capacitor.

For the first time!

A central source of science materials for young people

Now, for the first time, one central source for the most stimulating, enlightening and entertaining scientific materials for bright young minds . . . painstakingly tested and selected (or specially designed) in consultation with practicing scientists and educators. Thirty-six illustrated pages of fascinating items for youngsters from pre-school to high school age . . . in a wide range of science subjects from astronomy to magnetism, from chemistry to nature study . . . with emphasis on projects for classroom use by teacher and student.

WRITE FOR **FREE CATALOG**

SCIENCE MATERIALS CENTER
A Division of
The Library of Science
59 Fourth Ave., Dept. M-20
New York 3, N.Y.

PITFALLS IN PLANNING

By M. L. BLAUSTEIN

Chairman, Sciences, Watchung Hills Regional High School, Plainfield, N. J.

ONE OF THE GREATEST benefits that science teaching can provide is the chance for students to experience science phenomena, observe demonstrations, and participate in basic research. This chance for student "experience with the tools of the scientist" is also our greatest pitfall.

Teachers with little science background as well as those with vast training, are making the same mistake; they are teaching science, not children.

Each child is put through a series of planned programs of scientific fact-learning. Each child is aided to experience such phenomena as magnetism, electricity, acceleration, water pressure, and in other awe-inspiring and interesting units of scientific knowledge carefully planned as being necessary for student assimilation. Woe to the child who cannot remember that metals attract other metals, and that sound travels by vibrations, and that the frog is an amphibian. Woe to the teacher too, if the child is learning these facts without relating them to the total picture of his *immediate environment*.

Which teacher are you?

Do you teach your students about magnetic forces and use simple lodestones, magnets, compasses, and dry cells to demonstrate magnetic behavior? Do you have students participate in learning experiences so that the facts which are presented are well learned?

If you intended to teach magnetism—fine—but yours are sins of omission—your sights are low.

Which teacher are you?

Do you present to your students a well-planned program similar to teacher number one, with but one difference: magnetism is presented as one of many forces acting upon our environment and which can be demonstrated by simple experiences. You did not teach your students about magnetism alone, but rather its place in the order of things around us was made more specific. You showed how magnetism is a related force, not an isolated one. You did not teach about magnetism because you are expected to teach "some science" at your grade level; or if you are a secondary school teacher, you did not teach about magnetism because it follows electrostatics. You know your students and you want them to see two sides to the story of science.

One is the relationship which exists between all phases of science; not just in the realm of the subject you are teaching. You cut across subject lines because they are man-made. You showed the relationship of science to social studies, to mathematics, to music, and to all areas of living.

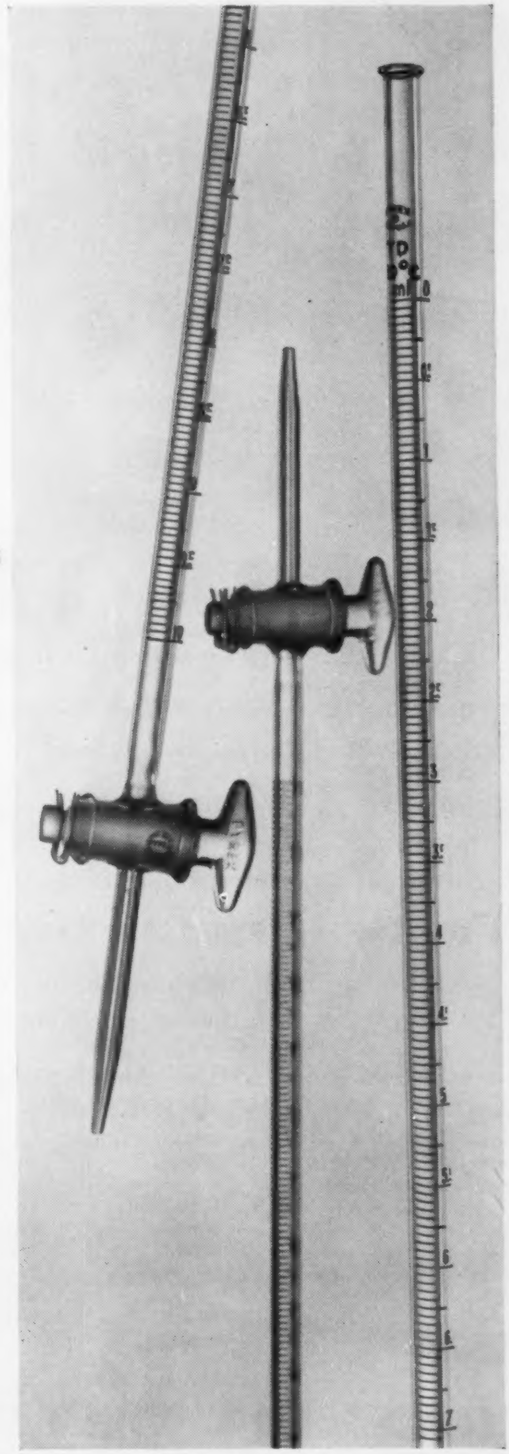
The second is the toughest of all, that of having each student see his role in the world around him. Remembering that the term *student* means the total individual in a total environment is not just mouthing vague Gestalt philosophy. A good student is a product of many things. One of the greatest errors a teacher may make is to teach a student isolated information and then expect him to do the difficult task of relating this knowledge to other subjects, to everyday living, and to the studied subject itself.

Whether or not you can place yourself in the role of teacher number two also depends on a number of things.

First, you must be a teacher of skill, understanding, and you must really like children. Secondly, you must be a little tired, overworked, and somewhat cynical and distrustful of panaceas in education. You are going to get the job done honestly, efficiently, and so that it does not have to be done over again—you haven't the time to teach poorly. You will not lean on science to "fill the gap" of daily routine, just because it's fashionable to teach science today. You will not use science topics as a crutch when students need livening up. You will not have students construct scientific projects without reason for them.

You will teach science so that the student knows that electricity is a related force, and that "how a light bulb works" is not the purpose of the lesson for the day. Johnny won't really know how a light bulb works, anyway, unless he sees it in relation to such areas of study as electron flow, magnetic forces, and others. It is quite doubtful if our educational aims have been ably carried out if the youngster cannot see the relationships between magnets, motors, and electron flow; or the similarity of the human skeleton to a lever, a ball and socket of a caster, and to a door hinge. It is also quite important for us as teachers to see first the relationships ourselves, if we are going to teach them to others.

NEW NEW NEW



Low-cost PYREX brand burettes

Now buy only the accuracy you need . . . at a price that makes sense

These new PYREX brand ACCU-RED Burettes are priced at 38% less than our precision (certified) models Nos. 2130 and 2131.

But they provide all the accuracy you need for many tasks that do not require *extreme* precision. For example, tolerance on the 25 ml size is ±0.06 ml.

Moreover, the low price does *not* mean any sacrifice in quality. You still get all the advantages of labware carefully crafted from PYREX brand glass No. 7740; no worries about corrosion or contamination.

And the easy-to-read markings are in to *stay* because ACCU-RED is *part* of the glass. Lines and figures will last as long as the burette does!

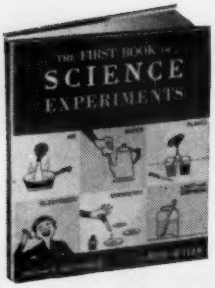
Other features include an improved pressure clip that holds the plug firmly in place and smoothly-finished, double-beveled tip.

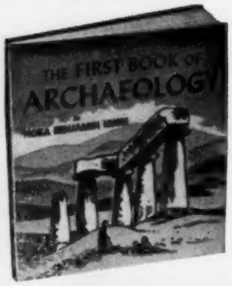
You can get these new burettes in 10, 25, 50 and 100 ml sizes . . . with ACCU-RED or white markings. Either type is the answer to your accuracy–at-a-price–need in quality labware.

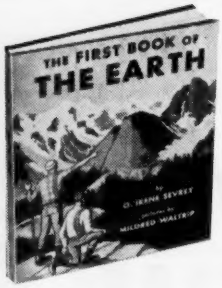
Contact your usual source of supply. Or take a detailed look at the full line of fine glass labware from Corning by sending for the basic reference, Catalog LG-1. Write to us at 77 Crystal Street, Corning, New York.

CORNING GLASS WORKS
CORNING MEANS RESEARCH IN GLASS

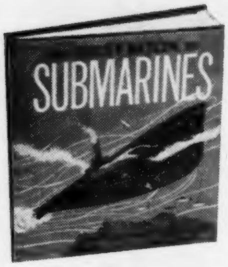
PYREX® laboratory ware *. . . the tested tool of modern research*

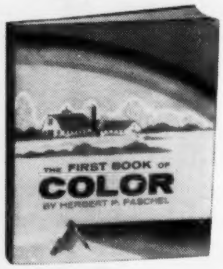




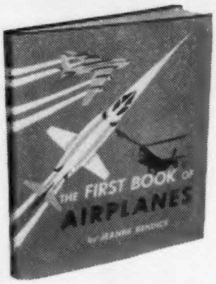


Representative Science Subjects in the Series





"FIRST BOOKS
should be found in every library to help children find answers to their 'first' questions . . . Information is presented differently in each book . . . Large type and profusely illustrated pages make them extremely attractive to children."
—*Grade Teacher*



The FIRST BOOKS

offer more to interest children and to stimulate supplementary reading than any other group of informational books for young people

Supplied at no extra cost in the

Watts Guaranteed Library Binding

—guaranteed for satisfactory library service, or the book replaced free of charge

Dozens of Science FIRST BOOKS to choose from! . . . The FIRST BOOKS of—

Airplanes	**Conservation**	**Photography**	**Space Travel**
Antarctic	**Cotton**	**Plants**	**Stones**
Archaeology	**Earth**	**Prehistoric Animals**	**Submarines**
Automobiles	**Electricity**	**Rhythms**	**Television**
Bees	**Food**	**Roads**	**Trains**
Birds	**Glass**	**Science Experiments**	**Trees**
Bridges	**Mammals**	**Sea Shells**	**Tropical Mammals**
Bugs	**Maps and Globes**	**Snakes**	**Weather**
Caves	**Microbes**		
Color			

ALL in the Watts Guaranteed Library Binding

ALL printed in LARGE, CLEAR TYPE

ALL fully illustrated.

ALL checked and double-checked for accuracy, authority, and clarity of text.

ALL 7⅜ x 8¾ size

ALL at the net price of only $1.46 each to Schools and Libraries.

FREE

Send for new 44-page Dewey Classification Catalog of over 100 First Books and other publications of Franklin Watts, Inc., of help to teachers of all grades. Address Dept. ST.

FRANKLIN WATTS, Inc.

A Division of The Grolier Society Inc.

575 Lexington Ave., New York 22, N. Y.

Sixth graders clear ground.

Parents assist in the project.

WE ADDED A CLASSROOM

By STEPHEN S. ISRAEL and HERBERT D. THIER

Principal, Birchwood School — Science Coordinator

Niskayuna Public Schools, Schenectady, N. Y.

September 1, 1958: Five acres of undeveloped woodland on the eighteen-acre Birchwood Elementary School site.

November 1, 1958: Fifteen hundred feet of nature trails with major species of trees identified. A 1000 square-foot pond and separate bog area accessible from the nature study trails.

June 1, 1959: Identification of shrubbery and plants completed. An outdoor teaching amphitheater constructed in the area. Border shrubbery and ground cover plantings completed. About 4000 seedlings planted in the nursery area.

The desire of many teachers in the Niskayuna School District, for a place to study the happenings of the natural world in their natural setting and relationship to each other, germinated the idea for a nature study center. Five acres of woodland on the Birchwood Elementary School site was ideally suited for this purpose. The area consisted of virtually undisturbed second growth woodland with a small stream, a bog area, a half acre cleared field, and a natural amphitheater.

On the advice of consultants from the New York State Conservation Department, the Nature Conservancy, the Mohawk Association of Scientists and Engineers, The Union College Biology Department, and the School District's Professional Staff, work was started on the development of the nature center.

The major work of clearing trails, building three bridges, and developing the pond site was carried out on a voluntary basis by members of the community and the school professional and custodial staffs. The final clearing of the trails and restoration of the natural appearance of the area near the bridges were completed by sixth-grade boys and girls at the Birchwood School. Members of the school community were happy to lend equipment such as a bulldozer, chain saw, tractors, and other tools necessary for the development of *their* school nature center. Area businessmen contributed expendable materials such as old telephone poles for the bridge supports, used reinforced concrete slabs for the pond spillway. The money needed for the purchase of lumber and trail markers was donated by the Parent Teacher Association and the local Kiwanis Club. The entire project was financed in terms of money, equipment, labor, and materials by voluntary contributions of the school community. The result has been the transformation of five acres of unused space into an outdoor classroom where boys and girls can learn from, rather than about nature.

The school and community working side by side developed understanding and appreciation for the goals and accomplishments an educational partnership could provide.

New Chemistry Test

The National Science Teachers Association and the Examinations Committee of the American Chemical Society announce the availability (April 1, 1959) of the Form 1959. NSTA-ACS Cooperative Test in High School Chemistry. New, designed as an end-of-year achievement test in high school chemistry. Produced by cooperative effort of active chemistry teachers and experts in test construction with technical advice from the Testing Bureau and Statistical Department of Saint Louis University. The test is under the sponsorship of the National Science Teachers Association and the Examinations Committee of the American Chemical Society on a non-profit basis.

Effort was made to reduce reading difficulty, thus allowing the student to respond to a sufficient number of items to get good reliability. The examination consists of two parts of approximately equal difficulty. Each part has 50 items to be completed in 40 minutes. Thus the two parts can be administered in a single period of 80 minutes or in two periods of 40 minutes each. Either part may be used alone; however, greater reliability is to be expected when both parts are used.

Since this test is new, norms on the Form 1959 will not be available until September 1959. Teachers who need a test with established norms can still obtain the Form N test (1957). Test booklets and answer sheets are supplied in multiples of 25 at $4.00 per package of test booklets and $1.00 per package of answer sheets.

For further information, write: Examinations Committee—ACS, Saint Louis University, 1402 South Grand Boulevard, St. Louis 4, Missouri.

BIBLIOGRAPHY OF SCIENCE MATERIALS. For a complete Science Bibliography with over 500 items described for all sciences, send $1.50 to *Science Bibliography of Free and Inexpensive Materials,* Barbara F. Tea, Ed., Versailles, Ky.

A superb revision of an outstanding textbook series

THE WONDERWORLD OF SCIENCE

Revised

1957-1958 Edition for Grades 1-8,

By Knox, Stone, Meister, Noble, Wheatley, Shoemaker, and Kierstead

Gifted artists were teamed with the notable authors who made the WONDERWORLD series great from the date of its first publication. The result is a series which will continue to set the standard for science textbooks in the elementary schools.

Before you buy any science books see THE WONDERWORLD OF SCIENCE—Revised.

For further information, write to

CHARLES SCRIBNER'S SONS

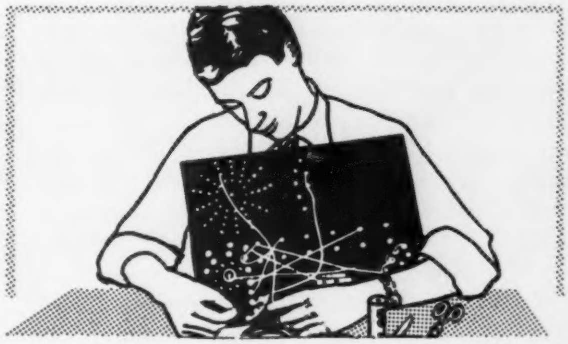
EDUCATIONAL DEPARTMENT, 597 Fifth Ave., New York 17, N. Y.

Make over 150 Small Computing and Reasoning Machines with . . . BRAINIAC®

A BETTER ELECTRIC BRAIN CONSTRUCTION KIT

EQUALS THE ORIGINAL GENIAC® electric brain construction kit (1955) **PLUS** many improvements and additions: over 600 parts—including 116 improved patented wipers so that all switches work well. Instead of covering only 33 machines, BRAINIAC gives full specifications for 151 computing, reasoning, arithmetical, logical, puzzle-solving and game-playing machines . . . all 33 GENIACS (1955), 13 TYNIACS (1956), and 105 BRAINIACS (1957-58), etc.

THIS IS BRAINIAC! With our Brainiac Kit K17, you can build over 150 small electric brain machines and toys which "think," compute, reason, and display intelligent behavior. Each one works on a single flashlight battery . . . is FUN to make, FUN to use and play with, and TEACHES you something new about electrical computing and reasoning circuits. All connections with nuts and bolts—no soldering required. Originated and produced excusively by Berkley Enterprises, Brainiac is the result of 8 years' design and development work with miniature mechanical brains including: Geniac (see "Geniacs: Small Electric Brain Machines and How to Make Them" by Edmund C. Berkeley, 64 pp., published by Geniac Project, a partnership with Oliver Garfield discontinued September 1955), Tyniac (1956), Relay Moe (automatic relay machine playing tit-tat-toe—pictured in Life Magazine, March 19, 1956), Simon (miniature automatic digital computer with 129 relays—see "Simple Simon" by E. C. Berkeley in Scientific American, November 1, 1950), Squee (electronic robot squirrel—see "Light Sensitive Electronic Beast" by E. C. Berkeley in Radio Electronics, Dec. 1951), etc.



WHAT CAN YOU MAKE WITH BRAINIAC KIT K17? Over 150 machines including—LOGIC MACHINES: Syllogism Prover, Intelligence Test, Boolean Algebra Circuits, Douglas MacDonald's Will Analyzer. A Simple Kalin-Burkhart Logical Truth Calculator, etc. GAME-PLAYING MACHINES: Tit-Tat-Toe, Nim, Wheeled Bandit, Black Match, Sundorra 21, etc. COMPUTERS: To add, subtract, multiply or divide using decimal or binary numbers. Forty-Year Calendar, Prime Number Indicator, Money-Changing Machine, etc. CRYPTOGRAPHIC MACHINES: Coders, Decoders, Lock with 15,000,000 Combinations, etc. PUZZLE-SOLVING MACHINES: The Missionaries and the Cannibals, Age-Guessing Machine, Submarine Rescue Chamber, Daisy Petal Machine, Fox-Hen-Corn & Hired Man, Uranium Space Ship and the Space Pirates, The Three Monkeys Who Spurned Evil, General Alarm at the Fortress of Dreadeerie, etc. QUIZ MACHINES: History, geography, trigonometry, grammar, statistics, calculus, etc.

WHAT COMES WITH YOUR BRAINIAC KIT . . .

Complete Plans, Instructions, Explanations & Hardware:

- Every part needed to build Geniacs, Tyniacs, Brainiacs—over 600 pieces including control panel, multiple switch discs, jumpers, improved wipers, bulbs, sockets, washers, wire, battery and special tools.
- Complete description of 151 experiments and machines.
- Over 160 circuit diagrams including 46 exact wiring templates.
- Manual "Tyniacs: Small Electric Brain Machines and How to Make Them" by Edmund C. Berkeley, 1956, 48 pages—includes Introduction to Boolean Algebra for Designing Circuits.
- "How to Go From Brainiacs and Geniacs to Automatic Computers" by Edmund C. Berkeley.
- Dr. Claude E. Shannon's historic 1938 paper given before the American Institute of Electrical Engineers: "A Symbolic Analysis of Relay and Switching Circuits," 12 pages.

only $17.95 . . . why pay more?

WHO IS EDMUND C. BERKELEY? Author of "Giant Brains or Machines That Think," Wiley 1949, 270 pp. (15,000 copies sold); author of "Computers: Their Operation and Applications," Reinhold, 1956, 366 pp.; Editor & Publisher of the magazine, *Computers and Automation;* Maker and Developer of small robots; Fellow of the Society of Actuaries; Secretary (1947-53) of the Association for Computing Machinery; Designer of all the Tyniacs and Brainiacs, more than half of the 33 Geniacs (1955); Designer of the patented Multiple Switch Disc and other features in the 1955 Geniac kit.

BRAINIAC KIT (1958 Model) K17 . . . the kit with limitless possibilities—backed by an organization of 10 years standing in the computer field...**$17.95**

(For shipment west of Mississippi, add 80¢: outside U. S. add $1.80)

7-Day Full Refund Guarantee If Not Satisfactory

MAIL THIS COUPON

BERKELEY ENTERPRISES, Inc.

815 Washington St., R187, Newtonville 60, Mass.

Please send me Brainiac Kit K17. (Returnable in 7 days for full refund if not satisfactory—if in good condition.) I enclose $.............................. in full payment.

My Name and Address are attached.

VIEWPOINT FOR MODERN SCIENCE

By SAM S. BLANC and GEORGE E. MATHES

Denver, Colorado, Public Schools

THE purposes of education in any society stem directly from the values and ideals of the society that maintains it. In American society, it is believed that the primary purpose of education is to help children acquire those facts, understandings, habits, and attitudes which will help them to become happy and useful members of a democratic society. Science education contributes to the purposes of education in general, since all youths need to understand the basic principles, facts, skills, and methods of science in order to live successfully in our modern society.

Recent changes in the patterns of daily life resulting from scientific advances call for an effective program of education in which science is a vital part of the total educational program, rather than a separate aspect of learning. The science student must have a sound foundation in the basic communication skills, for he must be able to read with comprehension, write with meaning, and speak with authority. To be successful in science, a student must be able to perform the basic mathematical computations with ease, and must also have an understanding of the more abstract concepts in the field. With new scientific developments occurring at an ever-increasing rate, the lessons learned from the study of history, geography, economics, and other related areas must be thoroughly understood. The science student must emerge as a well-rounded, mature, and competent individual.

Life today in our society is influenced greatly by modern science and technology. The simplest tasks have been revolutionized. Even education, slow to adopt "new-fangled-ideas," employs a hundred scientific devices from electronic test scoring machines to motion picture projectors. The public schools, therefore, have the responsibility of helping every child understand science and its implications.

Educators can no longer be satisfied to teach only the traditional science courses. Science experiences must be provided for all pupils, those who will terminate their formal education in high school, as well as those who will continue into college or university. Science teaching, therefore, has the dual role of contributing to the production of well-rounded, mature individuals, and of transmitting and adding to the heritage of scientific skills and understandings. If science is taught as a series of well-planned learning experiences, each of which contributes to the child's understanding of himself and his environment, it can truly play an important and vital role in the general education of the child. But, if a science course is to be an accumulation of odds and ends designed to fit into the curriculum only when nothing else can be found to take its place, then it can have only a superficial effect in the development of the child.

Science for younger children is a part of their daily life. It is impossible to exclude science experiences, yet they may not even hear the word science until they have had enough experience to give it meaning. Science should help them find answers to their questions. It can also help them think more critically, solve problems more successfully, and grow in appreciation of the natural and technical world in which they live. Science should make two important contributions to the development of children in the elementary school. It can help them begin to build an understanding of the basic principles of science, and it can help them develop a "let's-find-out," "how-does-it-work?" "what-made-it-happen?" point of view.

The work in junior high school science should be more closely integrated with the pupils' total school and out-of-school experiences. General science students vary with the schools, and even within the same school. Some have had wide experiences and exhibit a keen interest in the nature of science; others, unfortunately, have only a meager background. But, scientific principles operate the same for all persons, whether or not they are going to college, and regardless of their choice of occupation. Therefore, a functional program of science, based on essential

principles and their use in everyday living, must be provided to meet the needs of all pupils in the junior high school program.

In junior high school, also, the interest of the future scientist must be kindled. In a program where pupils learn by dealing with real experiences and by looking for answers to problems which directly concern them, functional understandings will take the place of arid, second-hand experiences which may have been the lot of so many pupils in science classes in the past. Through a strong science program, the way may be opened for the identification and recruitment of pupils who have an interest in science, and aptitudes and characteristics necessary for a successful science career. Guidance by the junior high school teacher is important in this process. The teacher must help students to choose wisely the areas of science in which to work and to set goals of achievement.

The senior high school science program should provide the opportunity for capable students who are interested in scientific careers to follow specialized programs in biology, chemistry, and physics. In addition, the opportunity must be provided for the general student to obtain sufficient understanding of the practical, avocational, and cultural aspects of science by means of a general program of electives in science.

Science education in the high school becomes functional as it becomes meaningful and challenging to the students. The interaction that exists between the learner and the learning experiences should be considered. This determines the extent to which the student identifies himself with the problems, understandings, and values of the course. The high school student is mature enough to know whether his training in science is fitting him for the career he has in mind. The public schools must provide courses which will meet these needs.

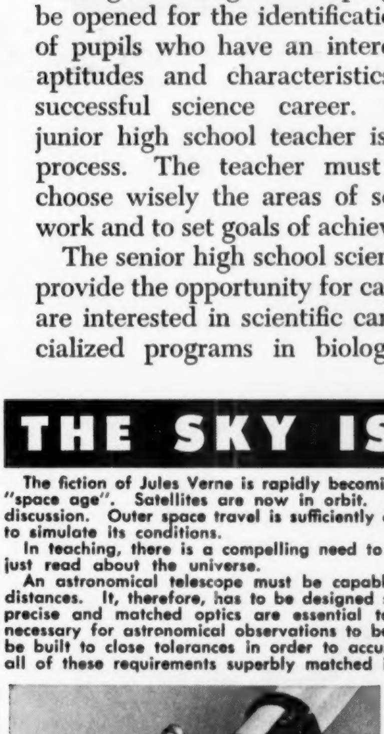
The zeal which pushes the mature research scientist is not unlike the spontaneous drive and curiosity of interested elementary and secondary school pupils. This can be nourished or it can be destroyed by the kind of science experiences which are provided in the science program of the public schools.

THE SKY IS THE LIMIT

The fiction of Jules Verne is rapidly becoming fact as the world begins to adapt to a new "space age". Satellites are now in orbit. Sending a rocket to the moon is under active discussion. Outer space travel is sufficiently close for the conducting of military experiments to simulate its conditions.

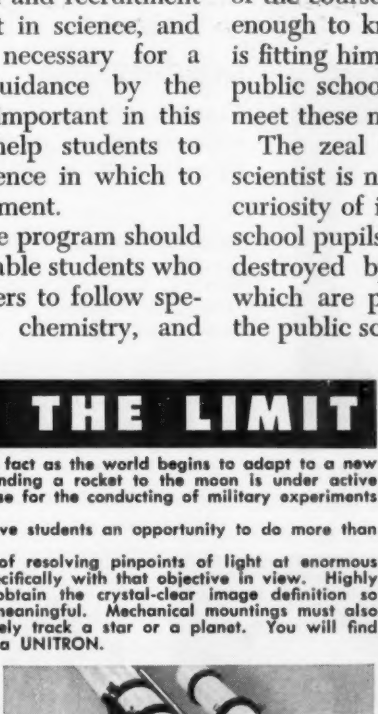
In teaching, there is a compelling need to give students an opportunity to do more than just read about the universe.

An astronomical telescope must be capable of resolving pinpoints of light at enormous distances. It, therefore, has to be designed specifically with that objective in view. Highly precise and matched optics are essential to obtain the crystal-clear image definition so necessary for astronomical observations to be meaningful. Mechanical mountings must also be built to close tolerances in order to accurately track a star or a planet. You will find all of these requirements superbly matched in a UNITRON.



2.4-Inch ALTAZIMUTH REFRACTOR

MODEL 114—COMPLETE with Altazimuth Mounting and slow motion controls for both altitude and azimuth, tripod, 5X-16mm. viewfinder, rack and pinion focusing, 4 eyepieces (100X, 72X, 50X, 35X), choice of UNIHEX rotary eyepiece selector or star diagonal and erecting prism system, sunglass, dewcap, dustcap, wooden cabinets, instructions .... $125.



4-Inch PHOTO-EQUATORIAL REFRACTOR

MODEL 166—COMPLETE with Equatorial Mounting and slow motion controls for declination and R.A., setting circles with verniers, clock drive, metal pier, Astro-Camera, 10X-42mm. viewfinder, 2.4" guide telescope, rack and pinion focusing, 9 eyepieces (375X-25X). Super-UNIHEX rotary eyepiece selector, sunglass solar aperture diaphragm, UNIBALANCE, dewcap, dustcap, wooden cabinets, instructions .... $1280.

UNITRON telescopes are America's largest selling refractors. They have withstood the test of time and are fully guaranteed. There are 16 models to choose from and easy payment terms are available.

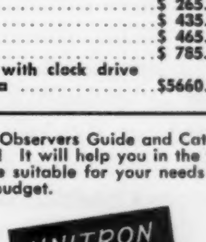
Here is a selection of UNITRON Refractors:

1.6" Altazimuth	$ 75.00
2.4" Equatorial	$ 225.00
3" Altazimuth	$ 265.00
3" Equatorial	$ 435.00
4" Altazimuth	$ 465.00
4" Equatorial	$ 785.00
6" Photo-Equatorial with clock drive and Astro-Camera	$5660.00

This valuable 38-page Observers Guide and Catalog is yours for the asking! It will help you in the wise selection of a telescope suitable for your needs and at a price to fit your budget.

Contents include—

- Observing the sun, moon, planets and wonders of the sky
- Constellation map
- Hints for observers
- Glossary of telescope terms
- How to choose a telescope
- Amateur clubs and research programs



UNITRON

INSTRUMENT DIVISION of UNITED SCIENTIFIC CO.
204-206 MILK STREET • BOSTON 9, MASS.

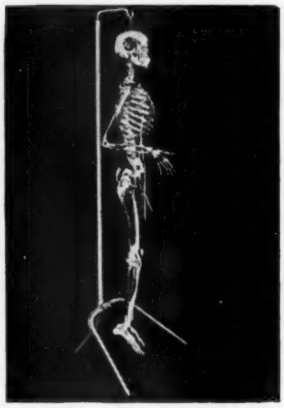
Please rush to me, free of charge, UNITRON's new Observer's Guide and Telescope Catalog. Dept. 8PT.

Name ____________________

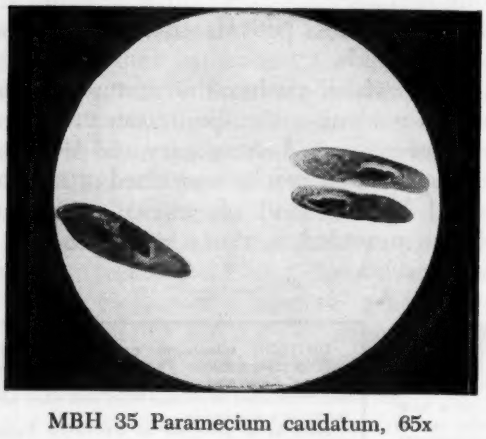
Street ____________________

City ____________ State ________

PLASTIC SKELETONS, SKULLS Durable, extremely realistic reproductions. Every bone in Clay-Adams plastic skeletons is cast individually in natural color, in mold impressions taken from a normal human specimen. They are easily cleaned, and individual parts may be quickly replaced.



Which of these Clay-Adams teaching aids can you use?



MBH 35 Paramecium caudatum, 65x

MEDICHROMES®

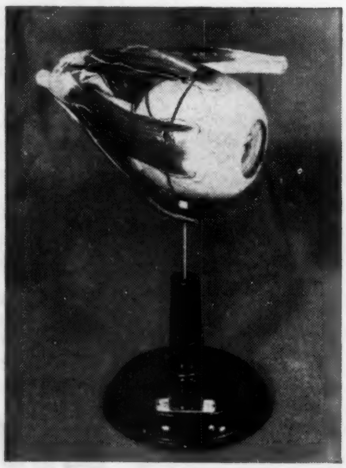
Finest 2 x 2″ Kodachrome presentations, prepared with the cooperation of recognized experts. More than 70 series available, including:

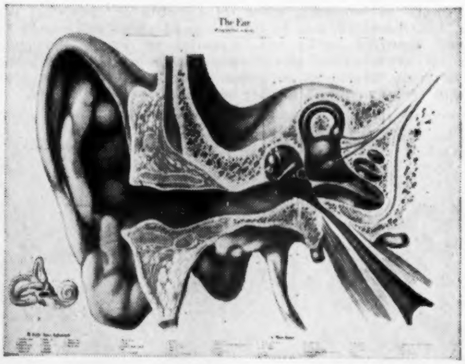
BIOLOGY (Series MBH). 530 slides made with the cooperation of Dr. A. M. Weckstein, Barringer High School, Newark, N. J. Selected to accompany Weckstein-Poster's *"Directed Activities in Biology,"* published by Oxford Book Company.

BOTANY (Series MBT). 103 photomicrographs for instruction in general botany, made with the cooperation of Dr. D. A. Johansen, Pomona, Calif.

ANATOMICAL MODELS

Large scale, anatomically accurate models of the human ear, eye, heart, and other organs are accompanied by detailed descriptive keys. Models are dissectible into component parts for more detailed study. They have been widely used as teaching aids for many years.





ANATOMY CHARTS Frohse, Schick, Michel, Bachin color wall charts of all human organs, systems, structures. Various types of mountings and cases are available.

Also available,

BOTANICAL and ZOOLOGICAL MODELS

PLEASE WRITE FOR

COMPLETE DESCRIPTIONS and prices on these and many other visual teaching aids.

Clay-Adams

141 East 25th Street, New York 10, N. Y.

Trends Regarding Science Teachers

By LUCY STARING, JOHN L. GARRETT, JR., and SAM ADAMS

Louisiana State University, Baton Rouge

THE AUTHORS HAVE PARTICIPATED in two studies dealing with people who teach science in the high schools of Louisiana. One of these studies was based upon the science-teacher group of 1948; the other, upon the group that was teaching science in 1956. While these studies were only roughly parallel, several trends are notable.

One such trend is that, despite the rapid increase of high-school enrollments, there were fewer people teaching science in 1956 (679 teachers) than in 1949 (699 teachers). An optimist might see in this a trend toward greater specialization on the part of those who teach science, *i.e.*, a school where two half-time science teachers formerly worked now has a full-time science teacher. However, far greater effort in this direction seems to be needed. For example, in 1956, only 6 per cent of the chemistry teachers taught a full schedule of chemistry; about the same per cent of physics teachers taught physics exclusively; slightly more than 10 per cent of the biology teachers taught biology on a full-time basis. The comparable figure for general science was 16 per cent.

In 1948, just over half of the science teachers were men; by 1956, two-thirds of them were men. The amount of teaching experience increased from a median of six years (1948) to nearly nine years (1956). Paralleling this, tenure in present position was somewhat higher for the 1956 group. This was especially notable among women teachers, the median having increased from 2.8 to 7.5 years during this interim.

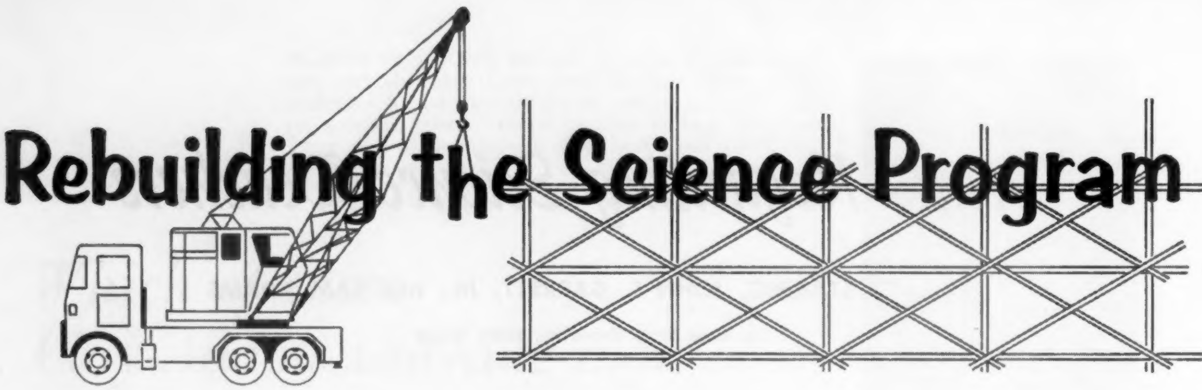
Also, considerable change occurred as to the educational status of the science teachers of Louisiana during the 1948-1956 period. In 1948, about 5.6 per cent did not have a college degree; by 1956, this figure was down to 0.44 per cent. Also, at the time of the first study, only 13.7 per cent of the group held graduate degrees. By 1956, almost 33 per cent held graduate degrees.

Many sweeping generalizations have been made regarding the status of science teachers—and practically all of them paint a gloomy picture. We feel however that by using an entire state as a sample and official records as sources of data, we can discern some trends that are not wholly discouraging. Some of these are: (1) slightly more specialization by teachers in the science area; (2) more men science teachers; (3) science teachers are more experienced and more stable; and (4) the level of college training has improved considerably.



LABORATORY
APRONS
and COATS
STANDARD FOR OVER 40 YEARS!
Quality APRONS at low group prices. Choice of sizes and materials.
Distinctive style - lightweight, comfortable, top quality LAB COATS.
SEND FOR
CIRCULAR No 17
FOR INFORMATION - MATERIAL SAMPLES AND PRICES ON LAB APRONS AND COATS.
CAN•PRO Corporation
17 E. McWilliams St. Fond du Lac, Wis.

A NATIONAL SERVICE
ALBERT TEACHERS AGENCY and COLLEGE BUREAU
Efficient, reliable and personalized service for teachers and schools. Under direct Albert management for three generations.
Original Albert Since 1885
Member NATA
37 S. WABASH AVE., CHICAGO 3, ILL.



Expansion of High School Chemistry

By JOHN T. STOCK

Associate Professor of Chemistry, University of Connecticut, Storrs

EVEN if the availability of sufficient specialist teachers is assumed, the much-discussed expansion of science teaching cannot occur without the availability of much equipment. Most of the sciences are not "armchair" subjects; they can be taught effectively only by a combination of classroom and laboratory instruction. Not only must laboratories be equipped but, especially for chemistry, they must be kept supplied with consumable materials. Large chemistry classes use up surprising amounts of chemicals, and even water and gas. They also require a considerable amount of storage and service space.

Small-scale Techniques

Considerable economies may be effected by the adoption, where suitable, of small-scale or semimicro techniques. Less-obvious advantages also gained are considerable reductions in accident risk, laboratory fume level, and in storage space requirements; the over-all effect is most marked with large groups of students. Additionally, some of the apparatus can be easily made. This not only permits further economy but provides excellent manipulative training.

Although dedication and enthusiasm are essential in teaching for maximum results, introductory qualitative inorganic analysis has much to recommend it as a high-school subject. Besides providing a broad background of facts to support blackboard work, it enables the student to acquire both skill and speed in manipulation. The systematic performance of analysis also encourages clear concise notebook records and provides an opportunity to prepare and study first-hand numerous compounds of the metallic elements. Working with about 0.5 ml portions of solution, very satisfactory separations and identifications can be performed with apparatus which is generally very simple. Many tests may be made with a single drop of reagent.

Handling of Gases

On this scale heating and evaporation are rapid operations and the favorable surface-to-volume ratio of the solution permits easy saturation with hydrogen sulfide without recourse to the wasteful bubbling method. Hydrogen sulfide treatment is carried out in a 75 mm x 10 mm test tube as shown in Figure 1 (a). Delivery attachment *A* is a 70-mm length of 5-mm outside diameter glass tubing, the bore of which is reduced to about 1 mm at the lower end. A short sleeve *B* of rubber tubing enables the attachment to be fitted snugly into the mouth of the test tube. After connection to the hydrogen sulfide generator, the attachment is placed loosely in the mouth of the test tube and the control stopcock is opened. When about 20 bubbles have passed through the gas washing bottle, the attachment is thrust fully home and the contents of the test tube are agitated for about a minute; this is best accomplished by tapping the test tube with the forefinger. The stopcock is closed and attachment disconnected.

Very little hydrogen sulfide is wasted, so that economy is coupled with a clean laboratory atmosphere. Properly controlled, a single Kipp generator charge will supply all of the gas needed for months, even if usage is heavy. At the beginning of a laboratory period the main stopcock is set *by the teacher* so that 2 to 3 bubbles per second pass through the gas-washing bottle. The gas then passes to a manifold carrying 2 to 4 delivery points, each of which has its own short rubber connecting tube and stopcock for student operation and control.

Another use of the attachment is for the detection of gases evolved during the tests. A 2-mm wide strip of filter paper *C* is moistened with a suitable reagent and inserted in the attachment as shown in Figure 1 (b). Examples are the detection of arsine by copper sulfate solution (2) and of sulfur dioxide by acidified potassium dichromate solution (1). (See listed references.)

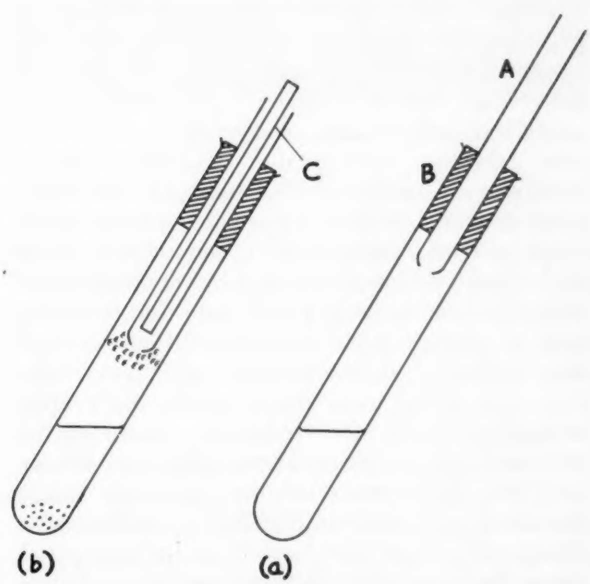


Figure 1. Gas attachment: (a) treatment of a solution with hydrogen sulfide (b) testing evolved gases.

Since the apparatus required by an individual student is small and simple, most of it can be accommodated in a block-type unit only about 9 inches long, as shown in Figure 2.[1] Evaporation of drops is carried out on a microscope slide, an ordinary small porcelain crucible being used for larger amounts. A miniature ring holder enables the crucible to be supported above a tiny flame.

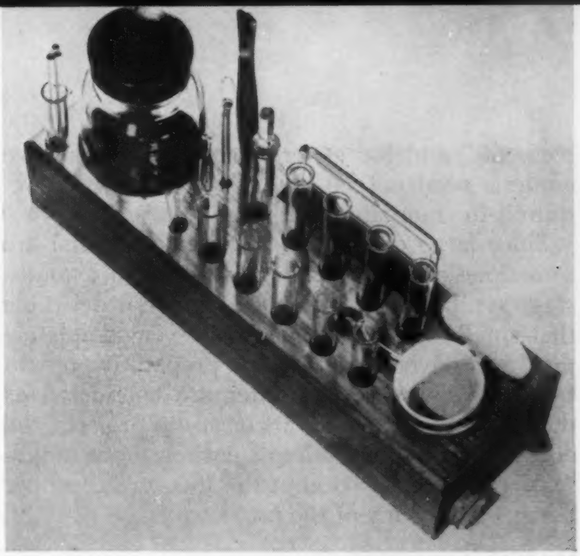


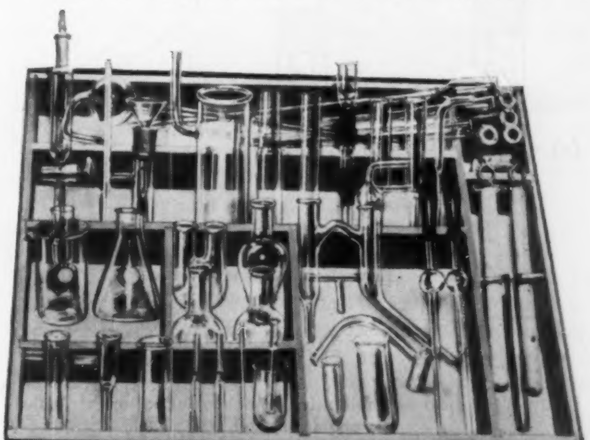
Figure 2. Unit for inorganic qualitative analysis.

Although extensive teaching of organic chemistry may be over-ambitious, even a limited treatment is worth having. Apart from the enormous number of carbon compounds, many of these are of vital importance. Further, the often-leisurely rate at which organic reactions proceed contrasts sharply with the rapidity of the ionic reactions which feature so largely in inorganic chemistry. This is reflected in the techniques employed.

Teaching Organic Chemistry

The "detection of elements" in organic compounds serves as an excellent bridge between inorganic and organic chemistry. Although the Lassaigne technique, involving fusion with metallic sodium, can be hazardous in the hands of beginners, practically all risks can be eliminated by scaling-down and by taking a few simple precautions (3). Proper manipulation enables highly satisfactory results to be obtained with sodium pellets weighing as little as 5 to 10 milligrams. A block-type unit suitable both for "detection of

Figure 3. Apparatus for small-scale organic operations.



[1] An improved form is manufactured by Aimer Products, Ltd., 56 Rochester Place, London, N.W. 1, England.

elements" and for general inorganic qualitative analysis need not be much larger than that required for inorganic work only.

Since large quantities of starting material are sometimes needed (as, for example, in a multistage synthesis), it is neither likely nor desirable that small-scale techniques will ever completely displace conventional organic preparative operations. If a few of the latter are conducted as demonstration experiments or group projects, the class may then work almost entirely upon small-scale experiments without the loss of the proper perspective in any of the projects.

Student Apparatus

Much can be done with a few test tubes and the like; however, the scope is much broadened by the use of simple apparatus specially designed for "gram-scale" working (4). Although economical and safe, this scale enables the none-too-skillful beginner to have some product to show for his efforts. As shown in Figure 3, the apparatus is stored in a shallow partitioned box about 15 inches long, thus allowing easy access and inspection.[2] A dozen of these boxes, each of which is provided with a lid showing various apparatus assemblies, may be stacked in the corner of a cupboard. Neck and stem sizes of the glassware are standardized, so that a single size of prebored cork may be used interchangeably. Together with simple spring mounting clamps, this system allows very rapid assembly and dismantling of apparatus and greatly reduces breakage risk. Two typical assemblies are shown in figure 4; that at (a) is for the continuous liquid extraction of a solid material contained in a filter-paper thimble. When the extraction is complete, the solvent may be distilled off by detaching the flask from the extractor and replacing the latter by the "reflux-and-distil" head as shown at (b); the same "cold finger" condenser is used in both assemblies. If it is necessary to reflux the extracted material with sodium hydroxide or other reagent, the requisite volume of the solution is introduced into the flask through the still-head, and the positions of cork *A* and condenser *B* are interchanged. When the mixture is boiled, the vapor is condensed and continuously returned to the flask.

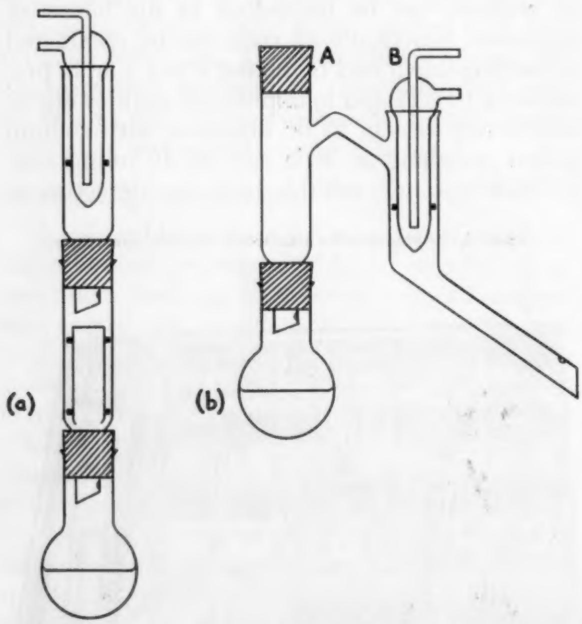


Figure 4. Typical assemblies: (a) continuous extractor (b) "reflux-and-distil" unit.

[2] The Ealing Corporation, Box 90, Natick, Mass.

Preassembled Demonstration Equipment

It is convenient for the teacher to have compact preassembled apparatus for demonstration purposes. From this thought sprang the double-sided small-scale organic preparative and analytical unit shown in Figure 5. This unit was exhibited during the 1952 International Congress on Analytical Chemistry and created a good deal of interest. An improved form which employs interchangeable glass cone joints throughout is therefore available commercially.[3] Although less than 30 inches long and weighing only 14 pounds, there are about 60 interchangeable pieces of glassware held in snap-in clips. One side of the main panel carries the simpler assemblies used for refluxing, melting-point determination, continuous extraction, and distillation. On the reverse side are units for steam, fractional, and vacuum distillation, while microfilters, or ice bath, are located on the end panel. Since the various condensers are connected in series, one rubber tube leading to a faucet and another running to the sink are sufficient.

A smaller and simpler unit which is suitable for more experienced students has recently been designed. By releasing a single thumbscrew, the rigid panel assembly may be taken apart. The whole, including glass parts, may therefore be stored in a flat box.

Other Teaching Possibilities

Various physicochemical operations, such as the determination of boiling point, vapor pressure, or molecular weight, can be readily per-

[3] The Arthur F. Smith Co., 311 Alexander St., Rochester 4, N. Y.

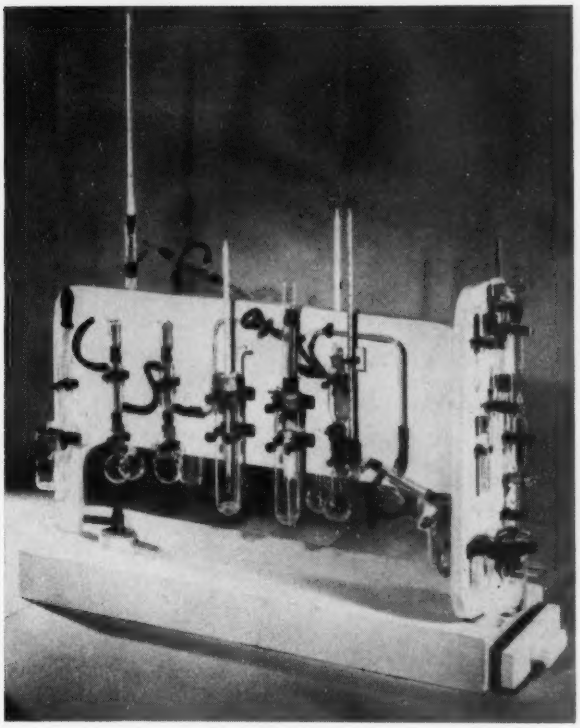


Figure 5. Miniature organic laboratory.

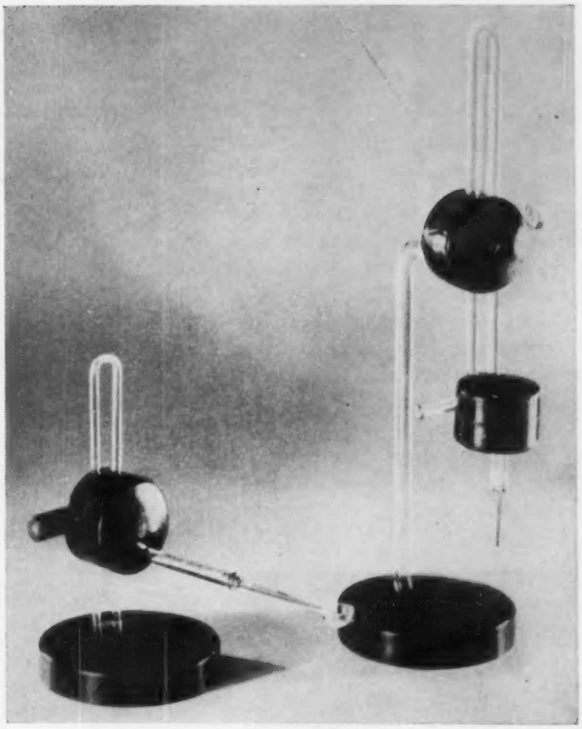


Figure 6. Utilization of reagent-bottle caps.

formed on the small scale and make good student exercises. An example is the determination of the molecular weight of acetone by the Dumas method; the only "special" apparatus is a 10-ml glass ampoule as used for containing solutions for injection. Since the determination is completed titrimetrically, the need for precise weighing is eliminated (5).

Small-scale conductometric and potentiometric electrode systems involve only an inch or two of thin platinum wire and are cheap and easy to construct. A conductometric titration unit energized by a bell transformer (6) or a transistorized potentiometric titrator(7) are examples of simple home-made instruments which may interest students who like to use a few tools.

Much other simple apparatus can be made from glass tubing and rod, plastic caps from reagent bottles, and others. Typical examples are the evaporating-spoon holder and the suction-operated turbine stirrer shown in Figure 6. These have rise-and-fall action controlled by rubber-tubing rollers which press on the sides of the glass "hairpin."

In conclusion, no matter how large or small your equipment, careful inventory and the proper care are essential requirements. The use of a student assistant for these tasks is recommended.

References

1. J. T. Stock and P. Heath. *Small-scale Inorganic Qualitative Analysis,* Chemical Publishing Co., New York. 1954.
2. J. T. Stock and L. M. Garcia. *Journal of Chemical Education* (in print).
3. J. T. Stock and M. A. Fill. *School Science Review,* 37:346. 1956.
4. J. T. Stock and M. A. Fill. "Introduction to Organic Chemistry." University Tutorial Press, Ltd., London. 1955.
5. J. T. Stock and T. R. Williams. *School Science Review* (in print).
6. J. T. Stock. *Journal of Chemical Education,* 31:410. 1954.
7. J. T. Stock. *Analyst,* 83:56. 1958.

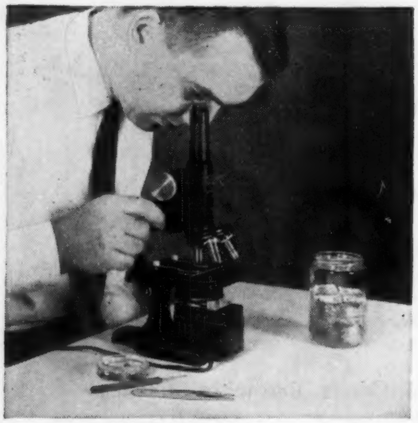
EXPEDITION LEADERS WANTED. Teachers with interests in natural history, native crafts, history, and photo-journalism needed for scientific groups exploring and collecting in the American Southwest. Opportunities for personal research. Men for boys' groups; women for girls' groups. Experience in camping essential. Salary and expenses. Eight weeks, July and August. Hillis L. Howie, 534 Woodleaf Court, St. Louis 22, Mo.

AO Reports on Teaching with the Microscope

Husbandry of Molds or Gentleman Farming in the Classroom

By: Mr. William Altfeld
New York School of Printing
New York, New York

This unique experiment is reproduced exactly as submitted by Mr. Altfeld. He has used it, with much success, in his general science classes at the New York School of Printing. We submit it to you as a fine way to introduce students to the study of microscopic common, non-green plant life, as well as to the importance and use of the microscope in biology. In a very simple way, it extends the field of microscopic creativity by utilizing ordinary, "everyday" materials...indeed, the dust from the very air that surrounds us.



Mr. Altfeld suggests using the AO Spencer No. 66 Compound Microscope. He didn't have to say that...but we are not unhappy that he did. You see, we know the AO No. 66 combines superb optical performance with rugged construction...is designed to service even the most active class. Full facts on the AO No. 66 are yours for the asking. Just write American Optical Company, Instrument Division, Dept. P95, Buffalo 15, N.Y. Complete information will reach you by return mail.

EXPERIMENT

Growth and microscope study of our common molds.

MATERIALS AND PREPARATIONS

1. AO Spencer No. 66 Compound Microscope with 10X eyepiece and 10X and 43X objectives.

2. A microscope lamp is also a worthy accessory.

3. Box of clean slides and cover slips.

4. Tweezers and teasing needles.

FOR THE MOLD CULTURES THEMSELVES

1. Thoroughly cleaned food jars with twist off caps e. g. those used for jam, peanut butter, mayonnaise etc:

2. Squares of stale bread (cut down to 1″ x 1″);

3. Newspaper;

4. Water;

5. Normal dust from the air.

PROCEDURE

1. Crumple a small handful of newspaper.

2. Sprinkle (do *not* soak) the newspaper with water until it is damp, but not limp.

3. Place the ball of damp paper into the bottom of a cleaned food jar (Fig. 1). With the cover on, this will provide a moisture chamber essential to the germination of mold spores.

4. Take a 1″ x 1″ square of stale dry bread and rub one side of it along a dusty surface of a table.

5. Carefully insert the square of bread into the prepared jar with the dusty side up (see Fig. 1).

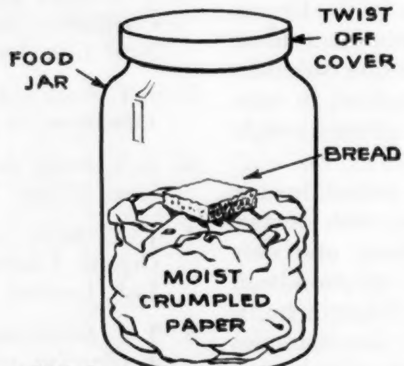


FIG. 1

6. With the cover of the jar replaced, the culture is now placed in a dark, warm, part of the room for several days.

7. A variety of colorful molds may be the reward for the careful mold gardener. However, the most common bread mold, Rhizopus nigricans ... a black mold with cottony mycelia will tend to steal the show.

8. After the molds have made their appearance, we can open our jars, and prepare to delve into the tiny world with the microscope.

9. With tweezers we snip off a sample of our common black mold. Place the sample on a clean slide into a drop of water. With teasing needles we separate the mass of hyphae. Then we prepare a temporary mount with a cover slip.

FIG. 2

10. Place slide under microscope and examine at 100X for an over-all view of the hyphae with their spore cases. Under higher power, 430X, we can observe the myriad spores which will have escaped their spore cases(see Fig. 2).

OBJECTIVES

The beginning students of biology will be able to appreciate the following facts:

1. Instructive experiments may be done with simple materials found in the home.

2. Molds do not originate from decaying matter, but rather from tiny "seed-like" spores, which themselves, germinate on decaying matter, and aid in that decay.

3. Mold plants are of many varieties just as our higher green plants.

4. The microscope is an essential tool in the understanding of the reproduction and growth of tiny plants.

Success with simple experiments may arouse students to try many others and so maintain an active interest in the science of life.

$25 For Your Experiment. We will pay $25.00 for each experiment involving either laboratory or stereoscopic microscopes accepted by us for future ads like this one. We're looking for unusual experiments suitable for the high school and junior college level. In the event of similar experiments the one bearing the earliest postmark will be used. The ad containing your experiment will bear your by-line. Write in now!

American Optical Company

Instrument Division • Buffalo 15, New York

Laboratory Science in the Small College —A New Approach*

By LESTER C. SHELL

Professor, Zoology and Chemistry, Central College, Fayette, Missouri

THE pre-professional student in medicine, dentistry, and laboratory technology in many large institutions has the opportunity to take courses in organic chemistry and general physiology in a special curriculum designed for such students. In such a course particular emphasis both in lecture and laboratory work is given to carbohydrates, proteins, lipids, sterols, and metabolism which would not normally be stressed as much in detail in a course taught primarily for majors and minors.

In the small college only one section of such a course is possible in which there will be majors, minors, or pre-professional students. In recent years young men interested in the sales promotion side of science, and young women interested in becoming science secretaries are coming into these courses for background material. In order to give an adequate background for majors and minors, some things must be stressed of less value to the other groups. Only cursory knowledge of carbohydrates, proteins, or fats, are fundamentally necessary for the major and minor.

Students from the small college going to a professional school are in competition with students from the large institution having had opportunity to take the more specialized background courses.

To prepare the pre-professional student and others not interested in taking a major or minor, two things are possible. First, through recitation or discussion groups, special emphasis can be given to electron structure, the mathematical side of science, sterioisomers, and electrical circuits for the majors and minors; while the application to metabolism, carbohydrates, proteins, or fats, can be presented in a similar section to the others.

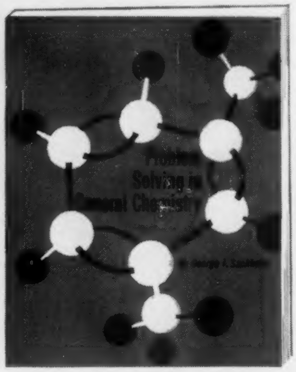
Second, in the last half of the course, after the fundamental materials of a more standardized course have been presented, the laboratory work can be so arranged to give each group opportunity to work with instruments, do special preparations, write reports, and possibly undertake a small research problem of interest to all.

Please keep in mind the fact that this new approach does not in any way eliminate the proper study of things fundamental to either organic chemistry or physiology such as distillation, crystallization melting points, extraction, chromatography, or the basic reactions of the hydrocarbons, alcohols, aldehydes, and ketones. These are considered fundamental to organic chemistry, as in physiology are the study of protoplasm, muscles, nerves, sense organs, circulation, respiration, digestion, and excretion. But the different groups apply these fundamentals to different systems, different individual compounds, more closely related to their fields.

This approach to a laboratory science has been given in our institution for the past 10 years, with considerable variation in the experimentation in laboratory allowed during the second half of the course. We have found, by careful follow-up studies of our graduates that they have done better work in graduate and professional schools than our own students had done previously, and better than students from some of our own area schools following the more conventional pattern of laboratory procedure.

* Presented by the author at the annual meeting of Section Q, Education, of the American Association for the Advancement of Science, Washington, D. C., December 1958.

NEW . . . for high schools



To help your student "see through" and solve chemistry problems on his own

PROBLEM SOLVING IN GENERAL CHEMISTRY

Provides the high school student with groundwork in the mathematics of chemistry . . . Gives complete step-by-step instruction on how to solve chemistry problems . . . Contains over 1100 examples and problems.

Write for full details

Row, Peterson and Company
Evanston, Ill. White Plains, N. Y.

TURTOX NEWS

Turtox News has been published monthly by General Biological Supply House since 1923. This illustrated bulletin is mailed gratis to more than 54,000 teachers and biologists in the United States and in more than ninety other countries.

May we send the current issue and place your name on the mailing list?

General Biological Supply House, Inc.
8200 So. Hoyne Ave.
Chicago 20, Illinois

It is our feeling that in organic chemistry, while the major and minor student makes such standard organic preparations as diethylmalonate, or acetoacetic ester, or pinacol hydrate, the premedical student would get more value out of a preparation as one of the sulfa drugs, a dye with medical importance, or an amino acid from some natural source. The pre-dental student, however, would be much more interested in preparing a local anaesthetic such as anesthesin or procaine. The laboratory technician in studying carbohydrates if allowed to learn the use of the Klett, or Spencer colorimeter on body fluids, or the spectrophotometer, or flame photometer would not only get the basic facts concerning the carbohydrates being studied but relate this specifically to his particular interests.

In general physiology, why not let the premedic do some experimentation on the endocrines, on blood, study the physiology of reproduction. The laboratory technician, the home-economics student, or the student training nurse would get greater value doing chemical tests on foods for the appearance of carbohydrates, proteins, fats, tracing metals, studying metabolism, and heat regulation, rather than doing experimentation involving a more intricate knowledge of electrical wiring or circuits.

We are all aware of the increasing importance and use made of chromatography, particularly the paper-strip type. While the major and minor in the area is determining amino-acid content of a mixture of acids prepared by a laboratory assistant, why not let one group of students determine the amino-acid content of a mixture of acids prepared by a laboratory assistant, and the other group of students determine the amino-acid content of some organism such as the grasshopper, the crayfish, frog muscle, or others. Chromatography making use of leaves, colored insects, and others would give similar results. By relating the particular experiment on chromatography to something within the future realm of experience of the student, the same fundamental principles can be taught. Yet the practical side of the study as far as the individual student is concerned would be realized.

In our particular area many colleges are reporting greater interest on the part of the young women in becoming secretaries in scientific industry, hence they need basic knowledge and terminology in both zoology and chemistry and are taking courses beyond the elementary level. In organic chemistry, we feel a knowledge of the

use of scientific literature, taking dictation involving scientific terminology, calculating cost of doing experimentation, and abstracting articles from the literature of greater value than a half dozen or more of the usual preparations done in the laboratory.

For those interested in business and economics but desiring scientific knowledge to enable them to go into industry, cost calculation of one method of preparation versus another, how to use literature, outside reading, becoming familiar with terminology, are more important to them than standard organic preparations. Yet to those majoring in an area the more standard preparations would have greater value.

An ideal arrangement for such a course would be two separate laboratories, as we currently operate in our institution. If this is not possible, placing of each group at a particular desk or desks would be satisfactory. This approach to a laboratory science does require considerable planning, yet we feel that the progress made is sufficient to compensate for the work done.

Conclusion

Apparently textbook writers are already anticipating this approach, as many of the current laboratory manuals have ideal experiments for these activities. The current edition of Fieser and Fieser, *Organic Chemistry Laboratory Manual,* devotes sections to use of the literature, cost calculating, abstracting, making special reagents which would be of particular value to the laboratory technician, as well as the nurse or the person interested in home economics. In physiology laboratory manuals as Walling's and others, special work on endocrines, heat regulation, metabolism, special tests for components of foods, and blood tests using new scientific instruments, are listed as possible optional experiments.

Many medical and dental school deans in our area have been quite interested in these training procedures and have been helpful in providing us with follow-up information as to the progress of our graduates. Several other small colleges in the Midwest have become interested in this new approach and have started to introduce it. Thus, the small college, with only one section of organic chemistry and general physiology can give better training to the pre-professional student and enable him to have almost the same type of basic training as the pre-professional student from the larger institution who has taken a course especially designed for him.

Rebuilding the Science Program

Advanced High School Chemistry

By JOHN F. YON

Chemistry Instructor, Altoona Senior High School, Pennsylvania

and WILLIAM McILWAINE

Associate Professor, State Teachers College, Millersville, Pennsylvania

ONE trend in some of the high schools today is that of making provision for the mentally gifted child in the field of science. Several different advanced courses have been or are being introduced into the curriculum to provide a richer background for secondary pupils.

In order to determine the type of program that should be offered and the topics that should be treated in such an advanced course in high school chemistry, a committee of four secondary school chemistry teachers at the Pennsylvania State University has made a study of the problem. They designed and sent out a questionnaire to 33 selected schools in the eastern area of the United States.

Of the questionnaires dispatched, twenty-three were returned. The returns indicated that private secondary schools and schools in areas of large college attendance tended to have or to be planning advanced courses in chemistry. Of the twenty-three replies, nine schools stated that they already had such a course, while five were planning to initiate one within the next year or two.

Several reasons were given for the lack of an advanced chemistry course in some of the schools. The biggest drawback seems to be the lack of qualified teachers to teach it. A second factor is the difficulty in fitting the course into the schedule of the school. Several schools were not interested because such a course was not adapted to the needs of their pupils.

Schools that had an advanced chemistry course pointed out that the type of program to be followed is one that emphasizes creative thought and gives advanced laboratory skills. Moreover, it should serve as a terminal course for students interested in chemical analysis as well as obtain for their students advanced placement in a college program.

From their experience the teachers indicated that the procedure to follow in class should be that of student demonstration of processes, wherever possible, and the project method of working on advanced chemical problems. A conflict of opinion arose as to whether the course should include subjects of greater depth or should try to give more breadth to the training of the student. As a whole, a broad coverage seemed to be preferred to that of a narrow coverage with greater depth.

In the survey teachers were asked to select topics that they felt should be treated in such an advanced course. Topics selected and the frequency of mention were:

a. Ionization and electrochemistry (12).
b. Radioactivity and nuclear chemistry (11).
c. Introductory organic chemistry (10).
d. Oxidation-reduction equations (10).
e. Solutions-theory and M and N solutions (10).
f. Chemical equations (9).
g. Wave mechanics and atomic structure (9).
h. Description of elements (9).
i. Nature of the chemical bond (7).
j. Periodic chart (7).
k. Qualitative analysis (7).
l. Acids, bases, salts, with emphasis on theories (7).

m. Mathematics (6).
n. Nature and states of matter (5).
o. Colloidal state (4).
p. Gas properties and problems (4).
q. Thermochemistry and radiation (3).
r. Quantitive analysis (3).
s. Kinetic theory (3).
t. Solid state and liquids (3).
u. Heavy metals (3).
v. Non-metals (2).
w. Light metals (3).
x. Colligative properties (2).
y. Atomic theory (2).
z. Electronics (2).
a′. Oxygen-hydrogen chemistry (2).
b′. Fundamental terms (2).
c′. Biochemistry
d′. Electronegativity
e′. Silicate industries

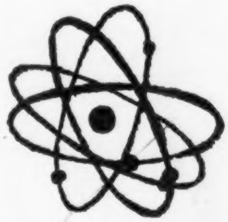
While only a relatively few schools are presently offering advanced chemistry, there is a trend toward making the course available in more and more of the progressive secondary schools of the country. It is hoped that the information gathered here may serve as a guide to those who contemplate introducing such a course in their own schools during the coming year.

THE UNIVERSITY OF COLORADO
BOULDER

announces the
1959 Summer Session
June 15-August 21
Graduate courses in
Applied Mathematics
Biology
Chemistry
Education
Geology
Mathematics
Physics
for the
Science and Mathematics Teacher.
For further information and a Summer Session Bulletin write to the Dean of the Summer Session, McKenna 8, University of Colorado, Boulder, Colo.

To spur students' interest in science . . .

To ready them for MORE science . . .



four problem-solving texts by Beauchamp, Mayfield, and West:

- **Science Problems 1**
  for Grade 7
- **Science Problems 2**
  for Grade 8
- **Science Problems 3**
  for Grade 9
- **Everyday Problems in Science**
  for high-school general science courses

SCOTT, FORESMAN AND COMPANY *Chicago 11 • Atlanta 5 • Dallas 2 Palo Alto • Fair Lawn, N.J.*

STANSI SCIENCE DEMONSTRATION TABLE. Manufactured to meet the specifications of the Chicago School Board for use in Elementary Schools. It is made of heavy gauge welded steel with a laminated wood and formica top. The top is 48 inches long, 28 inches wide and stands 36 inches above the floor. A large mirror, 22 inches by 40 inches reflects the whole table top from a height of over six feet. By tilting the mirror at a 45 degree angle students can observe in a vertical plane those experiments which must of necessity be performed on a horizontal plane. The water system consists of a nickel-plated brass pump, a stainless steel sink and plastic water containers. Electrical components are all water proof and underwriter approved. Tote-boxes have been substituted for drawers because they are more practical. The table rolls easily on substantial rubber wheels, two of which are equipped with brakes. **$295.00**

(Write for further information)

STANSI CHICAGO

STANSI SCIENTIFIC CO.
1231 NO. HONORE ST.
CHICAGO 22, ILLINOIS

Through the Microscope

By BRUCE A. LLOYD

Battle Creek, Michigan

FREQUENTLY PROBLEMS ARISE in teaching and prove to be rather unique. The solutions to those problems are sometimes well worth sharing. This problem had to do with taking pictures through a microscope.

A first attempt at photographing slides through a microscope proved to be a miserable failure in the sense that no pictures could be taken. It was not a complete failure, however, because the participants were even more anxious to achieve success and did not become discouraged.

The materials and equipment needed for this project are listed as follows:

Microscope	Ground-glass focuser
35-mm camera	Magnifying glass
Tripod	Microscope slides
Clamp-on flood lamp	Darkroom
Cable release	Fine-grain positive film

To begin with, the microscope was set up on the work table. The clamp-on flood lamp was placed in position so as to shine directly into the microscope mirror. This provided the illumination for viewing the slides. A prepared microscope slide was inserted in the proper place and the image was brought into focus.

The 35-mm camera was then mounted on the tripod. The tripod with the camera was placed on the work table in such a position that the lens of the camera was directly over the eye-piece of the microscope. Figure 1 shows the set-up.

When all was in place, the back of the camera was opened and the ground glass for focusing on the film plane was positioned.

It should be noted at this point that the distance setting on the camera was at infinity and the diaphragm was wide open (f. 3.5). The exposure was set on bulb (B) and held open.

Figure 1. Set-up showing position of equipment.

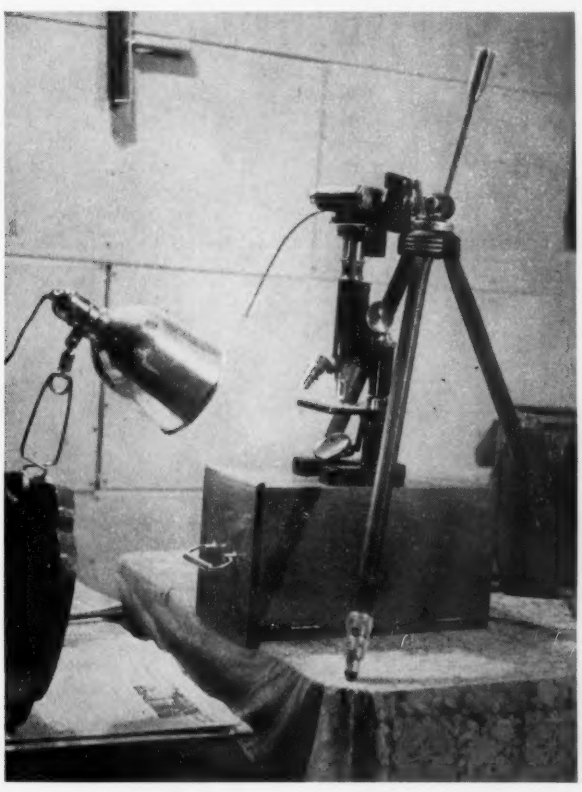
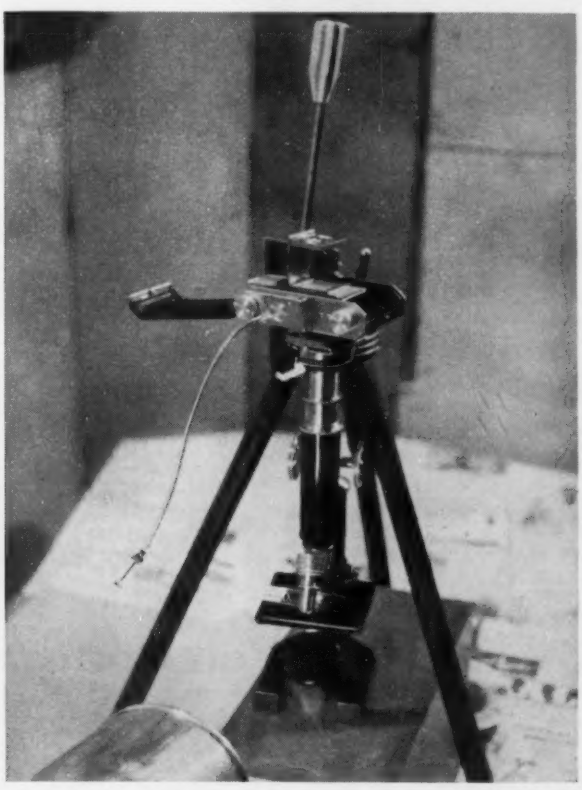
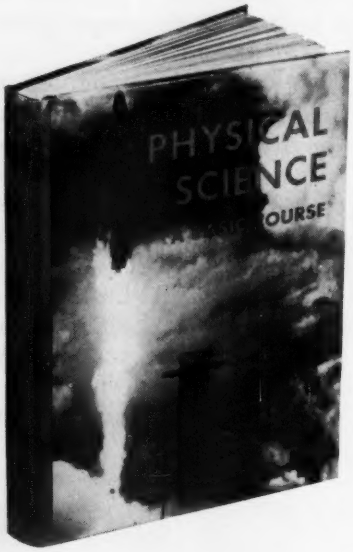


Figure 2. Focusing on the ground glass.



Can you ask for more?

When you are looking for science texts, can you ask for more than up-to-date and accurate coverage, a readable and stimulating narrative, a clear and sound pattern of organization, and rich, meaningful illustrations? These features are the hallmark of the Van Nostrand Science Program. Two of the recent additions are:



PHYSICAL SCIENCE

A BASIC COURSE

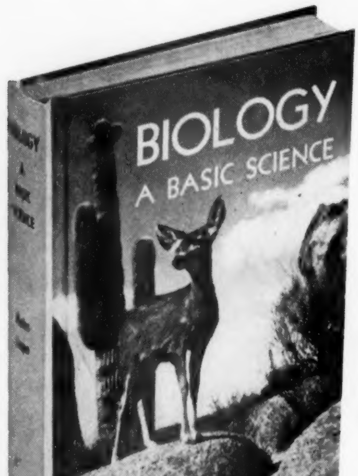
1959 edition **Hogg, Cross, Vordenberg**

To give students a real grasp of the importance of scientific achievements, this new text explores the basic principles of chemistry, physics, earth science, meteorology, and astronomy. Notable for simplicity of style, ease of vocabulary, and the use of everyday analogies, the text gives an integrated picture of the various branches of physical science.

BIOLOGY—A BASIC SCIENCE

1958 edition ***Heiss, Lape***

The study of biology becomes the exciting adventure it should be with this entirely new book, which involves the student in hundreds of absorbing activities. In a presentation as lively as a student's natural curiosity about the living world, it teaches the basic facts, concepts and principles of biology. Examine it and see for yourself why teachers all over the country are praising it.

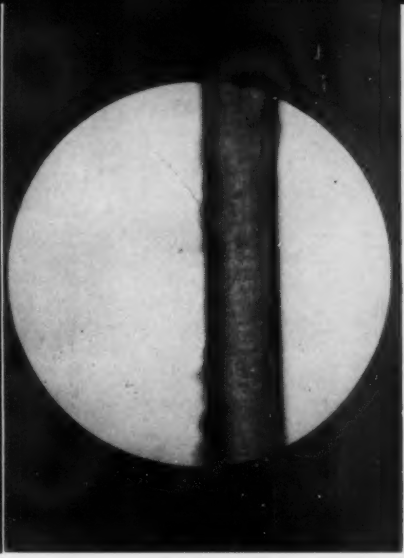


D. Van Nostrand Company, Inc.

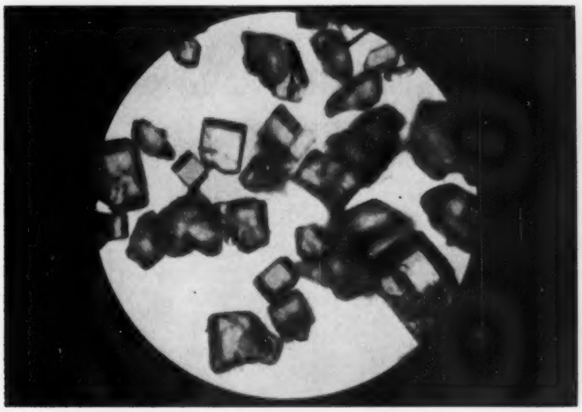
120 Alexander Street **Princeton, New Jersey**

Insect spiracle

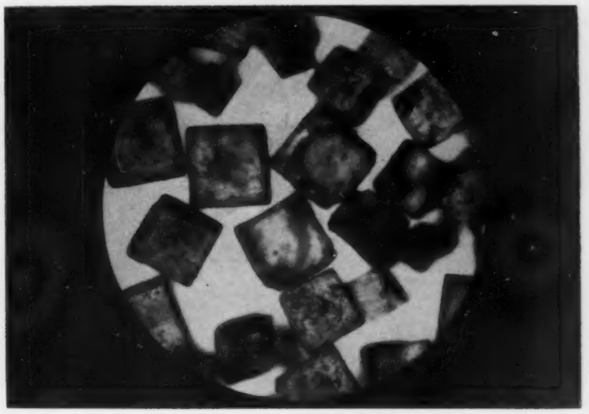
Head of mosquito



Human hair



Sugar



Sodium chloride

The image cast upon the ground glass was brought into sharp focus through minor adjustments *of the microscope*. After the image had been focused the ground glass was removed, the film inserted in the camera, the camera back closed, and the trial exposures were made. These trial exposures were made for two reasons: first of all it was necessary to be certain that the image would be in sharp focus. Also, the exposure index of the film had to be determined.

Trial exposures were made as follows: 1 sec; 2 sec; 4 sec; 8 sec; and 16 sec. The film was removed from the camera and processed in Dektol, diluted one part Dektol and two parts water. The developing of the film took five minutes and the rest of the processing was carried out in the usual manner.

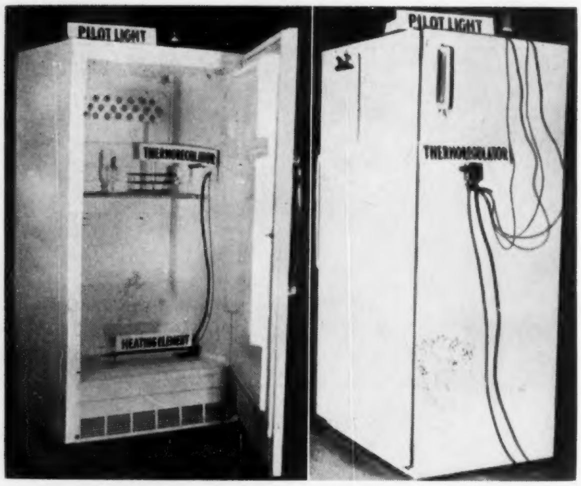
Upon examining the developed film, it was discovered that an exposure of one second was sufficient to produce a satisfactory image.

Altogether about sixteen separate prints were made. A few of them are shown in the accompanying illustrations. For each print made, it was necessary to focus separately the subject to be photographed.

Briefly, this was the procedure:

1. Position microscope slide with object to be photographed.
2. Open camera back, place ground glass focusing device in position on film plane, focus image.
3. Remove ground glass.
4. Place film in camera.
5. Make exposure.
6. Remove film from camera.
7. Develop film.
8. Print picture (after films dry).

What is the purpose of all this? It is simple. The problem was brought up. First failure, then success crowned these efforts. This is the way it was done. Now *you* can try it.



AN INCUBATOR FROM AN OLD REFRIGERATOR CABINET

By THEODORE J. AMMEL, JR. and CLARENCE W. RICE

Wayne State University   Cass Technical High School
Detroit, Michigan

AN old refrigerator cabinet, which has very little market value and may even be a hazard around the house, can be converted into a useful and inexpensive incubator for use in biology or other science laboratories by the installation of a thermoregulator and a heating element ready for use.

The refrigerator cabinet to be used should be checked to make sure that the seal around the door is in good condition, and that the door latch works well and holds securely. Otherwise, there is little damage that time and continued use could have done to it.

The thermoregulator can be purchased from a scientific supply house. It should be selected according to the temperature range and the degree of accuracy needed.

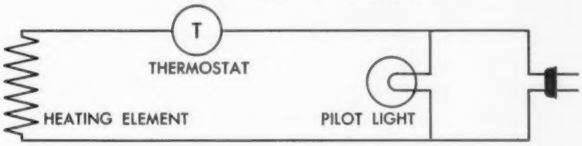
The electric heating element may be anything from an incandescent lamp to a commercial heating unit. Radiant heat is undesirable since objects which are good absorbers would be heated to temperatures well above that indicated by the thermoregulator. Radiant heat travels in straight lines and can be shielded by a metal plate placed a few inches above the heating element if shielding is needed.

The wattage of the heating element needed will depend upon several factors, the combined effects of which are difficult to determine except by trial and error. The amount of heat loss from the cabinet, the size of the cabinet, and the speed of temperature recovery desired are the principal factors. In the 11.5 cu-ft incubator constructed at Cass Technical High School in Detroit, Michigan, a 400-watt heating element gave a recovery of 4°C in 5 minutes over the entire operating range (20°C—60°C).

The heating element should be located at the bottom of the cabinet to facilitate the flow of convection currents. Metal refrigerator shelves of the wire or stamped type are ideal to permit the flow of air. The efficiency will be highest when the shelves are not overcrowded. A circulating fan could be wired to operate with the heating element, but satisfactory results were obtained without one.

The wiring scheme involves placing the heating element, the thermoregulator, and the circulating fan, where used, in series. A pilot light connected in parallel with heating element will go on when the heating element is operating. This is very useful in determining the speed of temperature recovery when the door has been opened. One power lead was wired directly to the heating element, and the other from the second terminal of the heating element back through the thermoregulator to the power supply. A manual on-off switch in series is convenient, and adds to the safety of the device. (See diagram.)

INCUBATOR WIRING DIAGRAM



In the unit at Cass, an indoor-outdoor thermometer was installed, and a reasonably accurate reading of the inside temperature could be made without opening the door. Since the capillary tube went between the door and the cabinet seal, installation was very simple. The ideal location of the thermometer bulb and the sensor of the thermoregulator is at, or near, the center of one of the side walls of the cabinet.

Caution should be used in operating the incubator at high temperatures. Plastic or synthetic materials of the refrigerator cabinet may soften at temperatures above 140° F. Precautions must be taken to prevent unauthorized students from tampering with the controls of the thermoregulator.

The old refrigeration unit can be left [illegible] the cabinet unless a refrigerant other than one of the Freons is used, in which case there is a potential danger if the refrigerant should leak out. Refrigerators built before 1938 may have used refrigerants other than one of the Freons. With the Freon-type refrigerator, removal of the refrigeration unit seems unnecessary, and any extra space gained from its removal would be useless, since it is not inside the insulated part.

The uses of an incubator in a biology laboratory are almost unlimited. It can be used to incubate hens' eggs, provided proper humidity is maintained. Biological growth (except in warm blooded animals) and chemical changes are usually speeded up by proper incubator temperatures; this saves time and the pupils' experiments are more interesting when the final results are obtained while the topic is still being studied by their class. Body enzymes work best at body temperature, but may work very poorly at room temperatures. Vitamin C oxidizes more rapidly with warmer temperatures. Yeast fermentation and growth of bacterial cultures can be speeded up greatly in an incubator. Absorption studies of radioisotopes can be made at different temperatures. The above are some of the projects which have kept the incubator at Cass Technical High School in constant use since construction.

Quantitative studies of the responses of protoplasm to different temperatures and the interpretation of their results would give general biology pupils an excellent exercise in the use of the scientific method. A real working experience with growth rates or fermentation rates of microorganisms would be very valuable in a general biology course and gives depth of meaning to such facts learned as those concerning food spoilage and raised body temperature as a defense against disease.

* The authors acknowledge help as follows: photos by Marvin Fishman, student at Cass; financial aid, Cass Tech Biology Club; suggestions by Dr. Peter Dean, Wayne State University, and Mr. Roy Hocking and Mr. Wilson Kispert, Cass Technical High School.

FREE!
SCIENCE TEACHING AIDS

From CENCO, for secondary teachers... pamphlets listing apparatus and supplies needed for demonstrations and experiments in science courses.

- Pamphlet GS6 General Science
- Pamphlet B8R2 Biology
- Pamphlet HSC-7 Chemistry
- Pamphlet P-12 (54 pgs.) Physics
- Pamphlet DMW Physics Workbook Experiments
- Pamphlet DMB Demonstration of Physical Laws

Write today listing pamphlets desired.

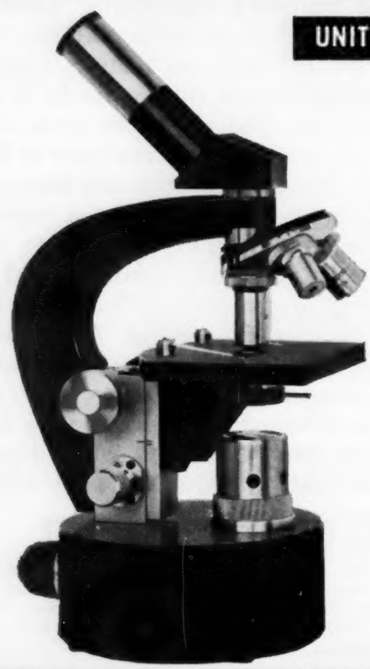
cenco ®

CENCO the most complete line of scientific instruments and laboratory supplies in the world.

CENTRAL SCIENTIFIC CO.
1718-O Irving Park Road • Chicago 13, Illinois
Branches and Warehouses — Mountainside, N. J.
Boston • Birmingham • Santa Clara • Los Angeles • Tulsa
Houston • Toronto • Montreal • Vancouver • Ottawa

UNITRON student microscopes offer

UNITRON STUDENT AUTO-ILLUMINATION MICROSCOPE, MSA



The UNITRON Student Auto-Illumination Microscope, Model MSA, employs a newly designed stand in which all components and controls are within easy reach. The inclined eyepiece tube allows comfortable posture and may be turned in any optional observing direction to permit two students sitting side by side to share a single instrument. With the built-in illuminating system of the superior low-voltage type, each student is assured of the correct lighting. The transformer is conveniently housed in the microscope base itself where it contributes to the stability of the stand rather than to the clutter of the laboratory table.

Model MSA comes complete with triple revolving nosepiece and three objectives: 4X, 10X, 40X; three eyepieces: 5X, 10X, 15X; coarse focusing with safety stop; fine focusing; condenser and iris diaphragm; filter holder and filter; accessory substage mirror; wooden cabinet and dustcover. Mechanical stage available at extra cost.

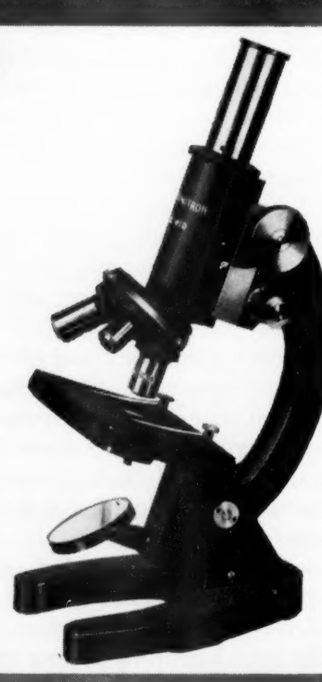
In quantities of
25 or more....$94.16 **only $107**

UNITRON STUDENT MICROSCOPE, MUS

Despite its low cost, UNITRON Model MUS offers features lacking even in much more costly models usually offered for student use. For example, both fine and coarse focusing are provided — not merely a single focusing control; an iris diaphragm to regulate aperture for highest resolution — not merely a disk diaphragm; and a condenser system for optimum illumination.

The optical performance of Model MUS at each of its magnifications is equivalent to that of expensive research models. All mechanical parts are machined to close tolerances and the stand is beautifully finished in black and chrome. Model MUS comes complete with triple revolving nosepiece and three objectives: 5X, 10X, 40X; choice of two eyepieces from: 5X, 10X, 15X; coarse focusing (accessory safety stop available); condenser with iris diaphragm; inclinable stand; plano-concave mirror; wooden cabinet and dustcover. Mechanical stage available at extra cost.

In quantities of
25 or more....$66.60 **only $74**



unexcelled quality at budget prices

UNITRON DISSECTING ADS

Heavy base, micrometric rack and pinion focusing, arm rests, mirror and background plate, large glass stage plate, Steinheil magnifiers.

ADS: for 10X, 20X **$32.50**

ADSA: for 5X, 10X, 20X **$36.50**

UNITRON PHASE MPEA

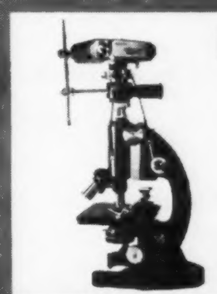
The first student phase model ever to be offered. Observe protozoa, plankton, etc. in the living state *without* chemical staining. Objectives: 4X, P10X, P40X. Eyepieces: 8X, 15X. Condenser and phase diaphragm. Write for a reprint of Professor Corrington's article on this remarkable instrument.

MPEA........... $99
(f.o.b. Boston)

UNITRON STEREOSCOPIC MSL

A wide field, binocular, 3-D dissecting model. Diopter and interpupillary adjustments. Removable glass stage plate. One set of eyepieces for 10X, 20X or 30X included; others available at extra cost.

Model MSL..... $110
(f.o.b. Boston)



UNITRON PHOTOMICROGRAPHY SET

Duplicates the performance of costly apparatus. Fits any standard microscope. Mounting brackets adjust for your camera. Viewing telescope allows focusing and selection of field while the camera is in position.

Model ACA... $39.95

UNITRON LABORATORY MLEB

Uses the same large, heavy stand as our research models. Three objectives: 4X, 10X, 40X; three eyepieces: 5X, 10X, 15X. Coarse and fine focusing. Condenser and iris diaphragm. Filter holder and filter. Mechanical stage available.

MLEB.......... $118

ACCEPT A FREE 10 DAY TRIAL

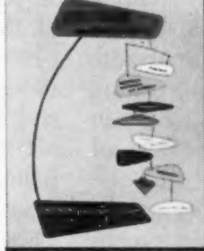
We invite you to try any UNITRON Microscope in your own classroom for 10 days at absolutely no cost or obligation. Let our instruments prove their value and quality to you, *before* you decide to purchase. You will see for yourself why UNITRON is the choice of America's leading universities, schools, and industrial laboratories.

THIS COMPLETE CATALOG ON UNITRON MICROSCOPES IS YOURS FOR THE ASKING!

Gives complete information on the UNITRON Models described above as well as on many others for all types of microscopy. You will find this informative publication a valuable addition to your files.

QUANTITY DISCOUNTS AVAILABLE ON ALL MODELS

Prices include wooden cabinet, plastic dustcover, and free delivery to your school unless otherwise noted.



UNITRON

INSTRUMENT DIVISION OF UNITED SCIENTIFIC CO.

204-206 Milk Street • Boston 9, Mass.

Please send me your complete catalog on UNITRON Microscopes 3P.

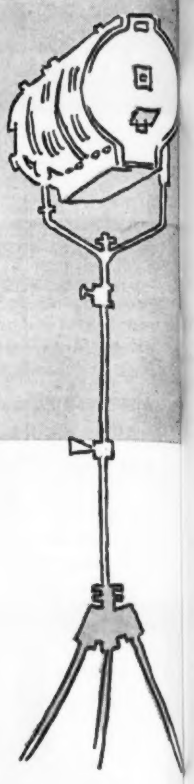
Name and Title__________

School or College__________

Address__________

City__________ State__________

SPOTLIGHT on RESEARCH



Use of Science Teaching Demonstrations

By EDITH M. SELBERG

Division of the Sciences, Colorado State College, Greeley

The results of the early investigations on the effectiveness of demonstration teaching have been evaluated in terms of certain criteria (13). This evaluation suggested that the results may be questionable because of the variability of methods used, incomplete control measures applied in teaching, and inadequate testing procedures used to measure learning. Science teachers now see that learning studies should be better controlled and that demonstration teaching can be used for many purposes not suggested by the early investigators.

Whether demonstrations or individual laboratory techniques are better for developing certain concepts and principles still needs to be investigated more extensively because of the nature of the learning involved in developing meanings, attitudes, and methods or skills in scientific inquiry. The psychological procedures needed for teaching each of these should be analyzed, demonstrations organized and taught according to the psychological elements involved. Also in demonstration teaching the comprehension of concepts, principles, and attitudes will be affected by the variabilities in classroom conditions, intellectual readiness of pupils, psychological class units, available materials, and teacher competencies (3, 8, 9). When these factors and the complexity of learning are known, slow pupils may learn better by the demonstration method than by the laboratory method as suggested by the early studies. From these and later studies, a defensible inference may be stated: namely, concepts and principles, or generalizations should be carefully analyzed for the essential elements and psychological procedures so that appropriate teaching procedures may be used to develop understanding. Too often the teaching of meaning, skills, and attitudes occurs without knowledge of the psychological procedures mandatory for their learning.

Teaching Concepts and Principles

When the demonstration technique is compared with other techniques, certain limitations as to its effectiveness are cited. McKibben (5) studied the relative value of learning activities which continued to an understanding of certain selected principles and determined whether each of the learning activities could be more appropriately taught by the demonstration or individual laboratory technique. In this investigation two hundred and seventy-three or 48.9% of the activities were designated by the evaluators as being better taught by the demonstration method than by the individual laboratory procedure. Thus it appears that the kind of learning demanded by an activity helps to determine the teaching technique. When students had been prepared to pass the regent examinations, Mallinson (4) found that the demonstration technique gave no better results than the individ-

ualized technique so that for the type of learning demanded in the examinations either technique may be usable. Smith (11) compared the demonstration technique with the sound motion technique by teaching the same kind of material. The investigation revealed that both techniques have equal merit and that the use of one is as effective as the two together for any level of pupil intelligence. In the development of laboratory resourcefulness, Goldstein (2) found that student laboratory work gave slightly more favorable results than did the demonstration technique. The above reports show that the technique employed tends to be determined by the end sought in learning.

The educational value of a demonstration should be appraised in terms of its contribution to the objectives of science. Each demonstration should be evaluated in terms of certain criteria such as the following: Has it developed an understanding of a principle? Has it fostered and developed attitudes pertinent to both learning and living? Has it developed abilities that are basic to the growth of intellectual competencies? These and additional questions are pertinent to demonstration teaching as well as other types of techniques.

Demonstrations can provide experiences in the use and development of problem-solving abilities. The question technique as used by Cahoon (1) can guide pupils' learning while the teacher demonstrates:

> What are the conclusions? What points did you actually observe? What ideas are inferred? Which are valid conclusions? What needs to be done to make the conclusions more valid? What are the assumptions that must be made to make the conclusion a valid one?

Additional evidence is offered by Teichman (14) who reports that demonstrations help students to develop ability to arrive at defensible conclusions when the technique is used for this purpose.

A way to improve learning has been suggested by Obourn (7) in his study of the role of assumptions. He states that "there is need for understanding the significance and place of assumptions as they are related to the acceptance of conclusions to the total pattern of problem-solving behaviors." In learning, the pupil is required to recognize the conditions, factors, or situations that should be considered to make the conclusion an acceptable and tenable one.

Many science teachers support the view that demonstrations can serve different functions (3, 9, 12), namely, developing understanding of principles, showing processes, indicating usable laboratory skills, collecting data, seeing and forming problems for study, generalizing, and making applications. Neal (6) in her study with elementary school children developed and used demonstrations to recognize and state problems, guide pupils in obtaining pertinent information, develop hypotheses, evaluate hypotheses, and make applications. Each of the demonstrations was organized and presented a specific element of problem solving. Evidence shows that pupils can develop methods of scientific inquiry through the use of the demonstration technique.

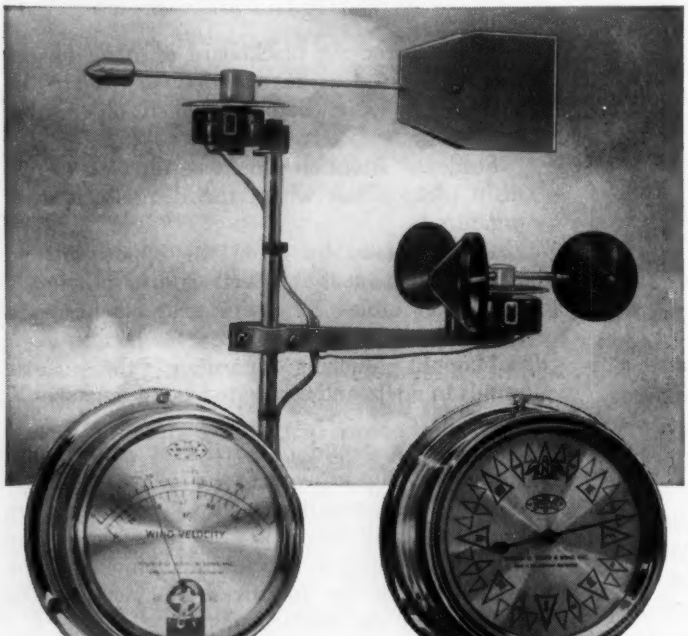
Procedures for Improvement

Teaching by demonstration is an important technique in science classes and is therefore one of the activities in which teachers should become skilled. Certain psychological procedures improve and enhance the learning that develops from either teacher or pupil demonstrations (10):

> The apparatus should be appropriately selected, arranged, and explained to pupils who can clearly observe the activity.
>
> An explanation should be given to indicate how the demonstration answers the problem of a unit.
>
> Diagrams on the blackboard or other devices should be used as an overview to explain the process or action before detailed observation occurs.
>
> Students' attention should be directed to few main ideas about which the demonstration is organized.
>
> Pupils should be given the opportunity to record the data as it is collected in previously prepared tables or previously determined methods of tabulation.
>
> Thought-provoking questions that cause pupils to relate and associate factual data should be used.
>
> Questions should be used that will require students to give answers to the following: What does the demonstration mean to you? What are the underlying assumptions? What facts are used in forming a conclusion? How can the demonstration be improved to increase the accuracy of the conclusion?
>
> Drill should be given on the main idea by going over the essential facts, showing an application, or requiring answers to questions.
>
> The demonstration should be organized to satisfy the elements of learning involved in the situation.

References

1. G. P. Cahoon. "Demonstrations Provide Experience in the Scientific Method." *Science Education,* 30:196-201.
2. Philip Goldstein. *Student Laboratory Work versus Teacher Demonstration as a Means of Developing Laboratory Resourcefulness,* Master's Thesis. College of City of New York, 1937; also *Science Education,* 21:185-193.
3. Elwood D. Heiss, Ellsworth S. Obourn, and Charles W. Hoffman. *Modern Science Teaching.* The Macmillan Company, 1950.
4. George G. Mallinson. "The Individual Laboratory Method Compared with Lecture Demonstration Method in Teaching General Biology." *Science Education,* 31:175-179.
5. Margaret J. McKibben, *An Analysis of Principles and Activities of Importance for General Biology Courses in High School,* Doctor's Dissertation. University of Pittsburgh, 1953; also *Science Education,* 39:187-196.
6. Louise A. Neal. *Techniques for Developing Methods of Scientific Inquiry in Children in Grades One Through Six,* Doctor's Dissertation. Colorado State College, Greeley. 1957.
7. Ellsworth S. Obourn. "The Role of Assumptions in Ninth Grade General Science." *Science Education,* 40:87-91.
8. E. F. Potthoff. "The Use of Demonstration in Science Teaching." *Science Education,* 29:253-255.
9. John S. Richardson. *Science Teaching in the Secondary Schools.* Prentice-Hall, Inc. 1957.
10. Edith M. Selberg. "A Plan for Developing a Better Technique in Giving Demonstrations." *Science Education,* 16:417-420.
11. Herbert A. Smith. "A Determination of the Relative Effectiveness of Sound Motion Pictures and Equivalent Teacher Demonstrations in Ninth Grade General Science." *Science Education,* 33:214-221.
12. Robert Stollberg. "Science Demonstrations for Improved Teaching." *The Science Teacher,* 22:277-279, 289-310.
13. Dewey B. Stuit and Max A. Englehart. "Critical Summary of the Research on the Lecture-Demonstration versus the Individual Laboratory Method of Teaching High School Chemistry." *Science Education,* 16:380-391.
14. Louis Teichman. "The Ability of Science Students to Make Conclusions." *Science Education,* 28:268-279.



White WINDMASTER

No. 409. Two matching dials, with 5½" mounting diameter, show wind speed up to 120 miles per hour and wind direction around full 360°. Speed dial has HI-LOW range switch and is self-powered. Direction dial has ON-OFF switch and requires either 110 volts a.c. or 6-volt battery. Complete with 5' mast, 60' cable, and hardware. Available in brass or chrome. **$122.50**

Units available separately:

Speed, **$55.00** Direction, **$67.50**

•

Complete weather stations for schools from $49.50 to $2750.00

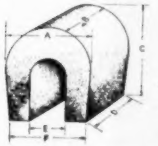
Write for Catalog

Science Associates

Instruments/Weather • Astronomy/Teaching Aids

P.O. Box 216 Princeton, N. J.

LOW-PRICE CLASSROOM AIDS for SCIENCE TEACHERS!



GIANT MAGNET! 5 lb. Size!

ALNICO V TYPE

A real bargain opportunity. A - 3¼"; B - 2¾"; C - 4 1/16"; D - 1¼"; E - 1¼"; F - 2⅝". Strength is about 2,000 Gauss. Will lift over 125 lbs.

Stock No. 70,183-AC..............$8.50 Postpaid

SMALL HORSESHOE MAGNETS

Magnets are always fascinating and educational. Here are some small but strong ones. These are very popular today for attaching papers to metal bulletin boards or steel partitions. Excellent for teaching physics. Size is 1⅛"x1 1/16". Faces are ⅜"x⅜".

Stock No. 40,275-AC..............set of two $1.00 Postpaid

Order by Stock No.—Send Check or M.O.—Satisfaction Guaranteed!

ERECT IMAGE LOW POWER MICROSCOPE

5X, 10X, 20X

$80 Value—Only $19.95. Extremely sturdy with rack and pinion focusing, color corrected optics, turnable microscope body for inclined viewing, three different powers, long working distance under objectives, sufficient eye relief for easy viewing. Made from war surplus optical instrument so that you actually get $80.00 of value. Weighs 4 lbs. 13" high. 10-DAY FREE TRIAL! Accessory objectives available for powers of 15X, 30X, 40X.

Stock No. 70,172-AC..............$19.95 Postpaid

COILED SPRING-WAVE DEMONSTRATOR

Triple length model of the popular "walk down the step" type toy, found to be excellent for demonstrating wave motion, observing pulses, understanding superposition and cancellation, etc. 3" dia.—6" long when compressed—expands out to about 50 ft.

Stock No. 70,178-AC.............. $2.00
Plus postage & packing.............. .50
Total $2.50

Order by Stock No.—Send Check or M.O.—Satisfaction Guaranteed!

NEW HAND SPECTROSCOPE

Never before such low price! Only possible because it employs newly developed replica grating film—with 13,400 lines per inch. This grating is mounted in aluminum tube 4½" long, ½" dia., with a fixed slit. Excellent for demonstrating spectrum; to see spectral lines of gases; for recognizing transmission and absorption bands of colored glasses, filters, dyes. Also will identify more prominent Fraunhofer Lines.

Stock No. 30,280-AC.............. $2.50 Postpaid

Order by Stock No.—Send Check or M.O.—Satisfaction Guaranteed!

TWO-STAGE ROCKET TOY—

Simple, safe—demonstrates principles of jet rockets. Uses water and air as fuel. First stage soars up 200 to 300 ft.—then 2nd stage is automatically released, going still higher. A 2nd stage satellite is also included and may be substituted. Made of Butyrate plastic. Set includes fuel supply tank and air injection pump.

Stock No. 70,157-AC .... $2.98 postpaid

Send Check or M.O. Satisfaction Guaranteed!

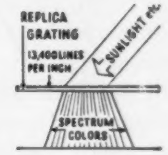
LOW FRICTION PUCK

DEMONSTRATES FRICTIONLESS MOTION

The 6" Diameter heavy chrome plated steel puck actually floats on a cushion of CO_2 gas. The slightest push on the side will send it skidding across a smooth surface. CO_2 gas is supplied by a standard fizz bottle cartridge and lasts from 10 to 15 minutes with proper valve adjustment. The bottom surface of puck is accurately finished. Spectacular in operation.

Stock No. 70,185-AC..............$22.50 Postpaid

REPLICA GRATING



Take Unusual Color Photos At Night!

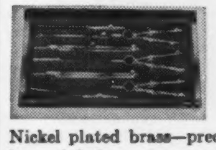
After decades of effort, low-cost diffraction grating replica film is available. This film has 13,400 lines per inch. Diffraction Grating has been used to answer more questions about the structure of the material world and the universe than any other single device. Use it for making spectroscopes, for experiments, as a fascinating novelty. Cheap enough that you can pass a piece out to each student. Produces beautiful view of spectrum. Comes in clear plastic protector.

Stock No. 50,202-AC—includes 2 pieces 8" x 5½"—1 transmission type, 1 reflecting type.............. $2.00 Pstpd.

Stock No. 50,180-AC—1 piece transmission type 8 in. x 6 ft. .... $5.95 Pstpd.

Stock No. 50,203-AC—1 piece reflecting type 8 in. x 6 ft. ....$10.95 Pstpd.

Order by Stock No.—Send Check or M.O.—Satisfaction Guaranteed!



CLOSE OUT! MECHANICAL DRAWING SET

Regular Price $18—Our Price Only $6.00

American mfr. couldn't compete with foreign imports—thus you get a terrific bargain, even far below import prices. 10 handsome pieces in velvet-lined case. Nickel plated brass—precision American-made. We guarantee you'll be satisfied or money refunded.

Stock No. 50,200-AC..............$6.00 Postpaid

Quantity Price: 5 Sets for $5.50 each Postpaid
10 Sets for $5.00 each Postpaid

EXCELLENT BUYS FOR CLASSROOM TEACHING

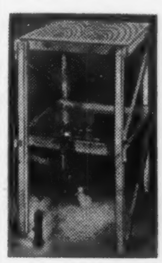
MOTOR STROBOSCOPE
Stock No. 70,179-AC..............$16.50 Postpaid

50X, 150X, 300X MICROSCOPE—REVOLVING TURRET
Stock No. 70,008-AC..............$14.95 Postpaid

STATIC ELECTRICITY GENERATOR—IMPROVED MODEL
Stock No. 70,070-AC..............$12.95 Postpaid

BUILD A SOLAR ENERGY FURNACE
Stock No. 70,130-AC—Fresnel Lens.............. $6.00 Postpaid

SLIDE RULE—CLOSE-OUT SALE!
Stock No. 30,288-AC.............. $3.00 Postpaid



RIPPLE TANK

Simplifies Teaching of Wave Motion of Light

One-piece, leak-proof tank is made of optically transparent plastic with a clear water area 20" x 20"... 1¼" deep. The rigid wood frame comes in two identical units, the bottom frame receiving the water tank and the upper frame holding a rigid, translucent, plastic projection screen. A clear bulb placed beneath the tank provides illumination for projection. Mechanism is actuated by an eccentric fastened directly to the small motor shaft. Wave vibrations are transmitted to the water surface through a leaf spring supported rod, to give parallel wave front or point source agitation with the supplementary attachment which is included. Motor is operated by two flashlight batteries in a brass case with a sturdy rheostat to vary the speed. Order today. Low cost permits purchase in quantity.

Stock No. 85,064-AC..............$40.00 f.o.b.
(Shipping weight 35 lbs.) Barrington, N. J.

Order by Stock No.—Send Check or M.O.—Satisfaction Guaranteed!

FREE CATALOG—AC

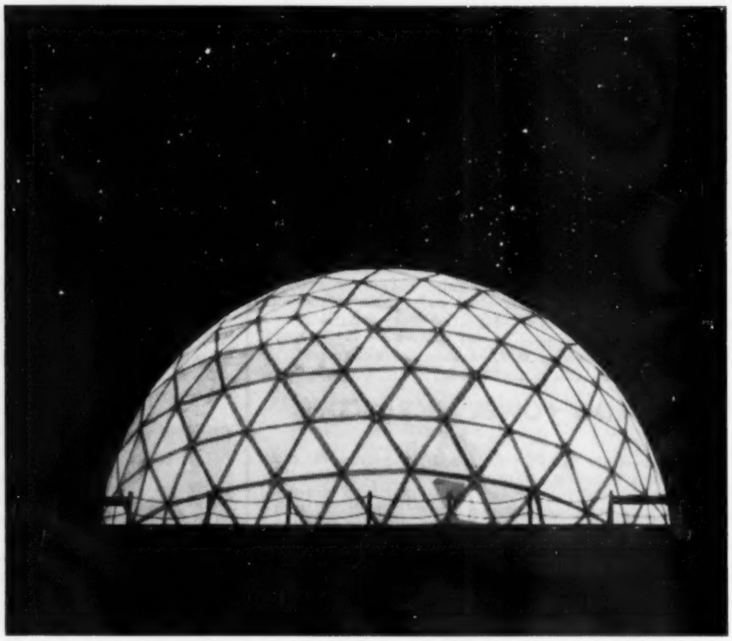
Yours for the asking

America's No. 1 source of supply for low-cost Science Teaching Aids, for experimenters, hobbyists. Complete line of Astronomical Telescope parts and assembled Telescopes. Also huge selection of lenses, prisms, war surplus optical instruments, parts and accessories. Telescopes, microscopes, satellite scopes, binoculars, infrared sniperscopes, etc. Request Catalog—AC, and FREE Bulletin 50-AC (on Science Teaching Aids).

EDMUND SCIENTIFIC CO.

BARRINGTON, NEW JERSEY

THE ARCTIC EYE THAT NEVER SLEEPS



This plastic radome houses a radar antenna constantly scanning the skies to detect the presence of aircraft. A long line of these radars provides early warning of any threatening approach to the North American continent.

The Distant Early Warning Line is now on perpetual guard duty. Spanning the Arctic from Baffin Island to Alaska, this great system was conceived at the Lincoln Laboratory of M.I.T. and produced under the leadership of Western Electric.

But first the DEW Line had to be engineered into a workable system. This was done at Bell Telephone Laboratories.

The obstacles were formidable. Conventional means of communication—telephone poles, cables and even line-of-sight microwave radio—weren't feasible. A complicated system had to be made to operate reliably in a climate so cold that outdoor maintenance is impracticable farther than a few hundred feet from heated habitation.

Whenever possible, Bell Laboratories engineers utilized well-proven art. But as it became necessary, they innovated. For example, they designed and directed the development of a new and superior radar which automatically scans the skies, pinpoints a plane and alerts the operator.

To reach around the horizon from one radar station to another, they applied on a massive scale a development which they pioneered—transmission by tropospheric scatter. Result: at a DEW Line Station you can dial directly a station more than a thousand miles away and converse as clearly as with your home telephone.

Bell Laboratories' contribution to the DEW Line demonstrates again how telephone science works for the defense of America.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

Sailsbury . . . from page 154

throughout in a given area. With a perfect or near perfect grade record and other interests and activities, it is felt that this extreme specialization should be permitted.

A lid covers far too many of the learning situations provided for young people—definite boundaries within which learning must take place. It seems that much of this must continue to be so for there is an ever-increasing quantity of information to be assimilated. Nevertheless, students should be supplied with opportunities, facilities, and time for independent studies.

For these and other reasons, all teaching in Seminars is done by its members, except for the first few weeks which are used to get each Seminar group off the ground in terms of the principles being presented here. Time during these first weeks of Seminar (four, five, six) is considered relatively unimportant since change in students comes slowly. The primary goal during this period is to shift them from students geared to specific assignments, homework, textbook, test and examination, grade, teacher, or supervised approach to ones who are reasonably well motivated to tackle unusual aspects of mathematics, science, and research because they so desire.

Additional Goals

Another primary aim has been to provide open-ended learning situations continuously whereby the breadth and depth of the student's knowledge and acquaintance with mathematics and science can be fostered to the extent which time permits. For this reason, the guiding principle that no content of high school courses would ever be considered has been followed.

Areas thus covered are: crystallography and some of its related mathematics, ion-exchange chemistry, sequestering agents, number systems, number theory, game theory, basic electronics, TV cameras and receivers, principles of radar, astronomy, red light shift, expanding universe, computers, contributions of mathematicians and scientists, nuclear physics, basic atomic particles, fission and fusion reactions, fallout, consideration of possible hypotheses of catalysis, basic systems of organic compounds, automation, symbolic logic, topology, and Interlinqua. New topics are regularly introduced. The present Seminars each contain individuals who have chosen geometrys, algebras, set theory, symbolic logic, and semiconductors, as topics to be presented.

Another aim during the formative period of each Seminar is to discuss current developments thoroughly and often enough so as to instill in the members the desire to remain up-to-date on their own. Thereafter, usually at the beginning of each period, students use a few minutes to comment on events which have occurred since the previous meeting. Bulletin board space is used to post coming school, community, college, and TV programs of particular interest.

Yet another aim is to engage in extensive exploration of the scientific method, research, and research techniques. Large numbers of specific examples are used. They are encouraged to speculate on possible approaches and solutions to current problems.

Rocketry, propulsion systems, trajectories, and space travel have always been topics of study. One member's paper (1945), was on the theoretical designs for a space ship and its nuclear reactor-ionic propulsion. No project on experimental test rockets has been approved. Theoretical studies in this area are encouraged. Incidentally, all Seminars have been puzzled as to why antiquated steam generators are used for the translation of atomic into electrical energy. They wonder why research did not focus on efficient direct conversion instead.

Locating suitable project ideas is a most difficult aspect of the Seminars. Subscriptions to *Science News Letter*, *Science Digest*, *The Scientific American*, and *Science* are taken for each Seminar. An elected librarian sees to the circulation of these and other materials. Each student reviews each issue and gives particular attention to the advertisements because of their value in suggesting projects. Project progress reports are given regularly in order to permit all members to benefit from the work of others.

Each student is responsible for securing all information and solving all situations relative to his project. He must originate and keep the initiative. He may use available resource persons. Little personal help outside of encouragement, direction, and assistance in the procurement of materials is offered. This is at first, and sometimes continually, bewildering to them since a faculty member is expected to continue as teacher. An individual teacher cannot comprehend all aspects of all projects which such students do. One can follow their data books, direct them in terms of logic, scientific method, or techniques, but merely as adviser.

Another rule used for approving a project is whether or not it contains a sufficient element of the unknown to make research and sincere investigation imperative. Here lies the primary difference between our science fair and Seminar projects. One significant clue to the unknowns contained in project plans is the recentness of the announcement of the idea, discovery, product, or process which is to be the basis for the student's project.

Not all project ideas are followed up. Several years ago one young man presented the idea for a valved, closed metal container with a gas under pressure to squirt out whipped cream.

Experience has shown that some of their projects were potentially ideas. Also involved here are the "rights" which must be signed away when their papers are submitted to various competitions. There is too much brain power and sincerity given to their undertakings for objectively original work not to result from time to time. This applies to similar students in other schools.

Approval was secured from the administration to explore this situation with a designated patent attorney. His opinions were in agreement with the preceding paragraphs. The services of his organization are now available to Seminar students who may come up with unusually significant ideas in the future. One is now being explored and others are in the planning stage.

Creativeness

A concept which has proved to be most useful in handling teaching situations and project work relates to the nature of creativeness. Historically, few persons create an original new idea, product, or process for the first time. One may define such creativeness as objectively new. One may create, however, an original idea, product, or process which is new to him but subsequently proves to have had prior discovery. Consider this second kind as being subjectively new. Prior to the time of any of these discoveries they are commonly known by others. The uniqueness and originality of the thinking, work, approaches, end product, and effects on the discoverer are all believed to be highly similar regardless of whether or not the discovery is objectively or subjectively new. High level, objectively new performances by students rarely take place. To try to cause creativeness to take place through formal teaching is a questionable undertaking. It is very doubtful that one can be told or shown by someone else how to make an objectively new discovery since the necessary details are obviously missing. One can, however, lead, guide, direct, or supervise someone else in making any number of subjectively new discoveries. It is felt that the effects produced on the individual's motivations, confidence in dealing with the completely unknown (to him), and habits of thinking are cumulative. When repeated often enough, with appropriate personal satisfactions, the individual can be caused to shift gradually from the learner making subjectively new discoveries under external suggestion, to a discoverer making objectively new ones on his own initiative.

One starts having the students do whatever new and different things he can do at the time. They must be related somehow to the general area he is undertaking. Patience—this is not a homework assignment due tomorrow to be graded. One underclassman spent three months growing six bean plants, all the while expecting to grow large numbers of different plants in order to investigate photoperiodism. This is progress for him since he had never grown plants before. The student is gradually led to undertake more varied, more complex, and more unknown aspects of his project as they arise. Most reach a point where they function on their own and are adequately satisfied with their accomplishments.

Herein lies a somewhat disturbing aspect of this work. Although much care is exercised in approving projects, there is an occasional one which cannot be concluded to the satisfaction of the student. In two instances the projects have been too comprehensive; in another the student had much success, but felt that inadequate work had been done. Such occurrences, since they represented ideal projects, seem to be inherent in the system.

Much adult scientific research is completed only after many years or is even uncompleted after generations of effort. Disease, photosynthesis, and cold light are examples. For this very reason students are not necessarily expected to complete their projects. Students, who undertake a major project and who do planned regular work on it, keep a data book with frequent, dated, and initialed entries, and write a final report on the work completed, are considered as having done a satisfactory project.

The sources of evaluations as to the worth of their projects are, in the order of their increasing importance, opinions of the student, opinions of

our staff, successes in national and state competitions, and opinions of appropriately specialized resource persons.

Each Seminar elects a chairman who serves as the director. He schedules reports, approves the giving of progress reports on projects, and supervises the discussions of current topics. An elected librarian sees to the circulation of periodicals and other reference materials and supervises the files of projects and bibliographical materials.

The Future

A laboratory for these students has been in the planning stages for several years. It will be installed during the summer of 1959. A multipurpose room was required, one in which biology laboratory sections could meet all periods, and also provide for the specialized needs of the relatively small number of Seminar members. Seminar students will use the laboratory before and after school hours and in small numbers (2, 3, 4) during their free periods, even though a biology laboratory section is meeting. This has been common practice for both sections.

Each year's experience has shown that this group of students includes advanced specialists in many areas. Efforts to bring about dissimmation of this information and know-how to underclassmen have been successful only to a small degree. This has always been regrettable. Each new group has had to start near a zero point.

With the new laboratory for a center one or two students will be trained and responsible for specialized skills information. Students will serve as experts to assist others on specialized aspects of project work and will also train one or two underclassmen before graduation. This will increase efficiency of the operation and also bring about a cumulatively increasing amount of know-how and information to new students.

Seminar should not be thought of as a course or a class. It is more properly to be thought of as a process by which talented students may have creative experiences in mathematics and/or science without restrictions and boundaries, except such practical ones as time, facilities, and safety. Their development has been both enjoyable and productive. The process is flexible and had small beginnings. It is hoped that this report will be of value to other teachers.

GRAF APSCO

CHICAGO U.S.A.

$105.30 EACH
in quantities of 5 or more
$117.00 EACH LIST PRICE

THE LATEST MODEL

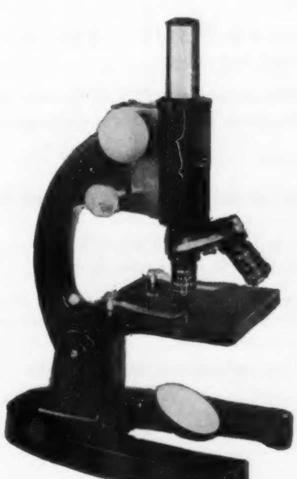
Graf-Apsco

STUDENT MICROSCOPE

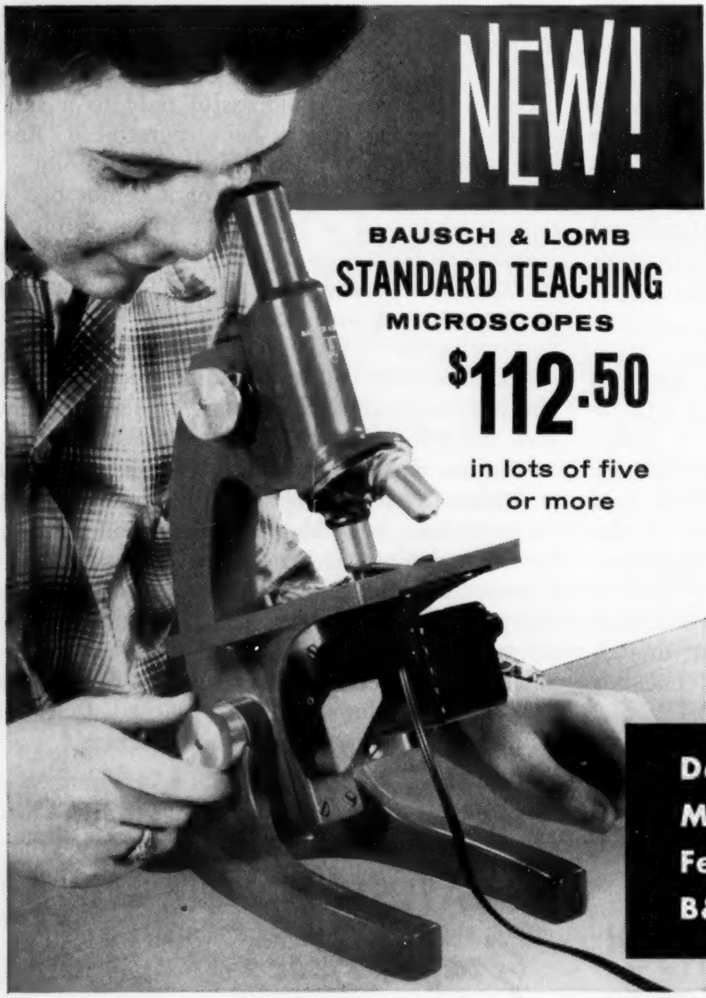
MODEL GB2A (WITH CONCAVE MIRROR)

ALL METAL CONSTRUCTION
INDEPENDENT FINE ADJUSTMENT (NOT ONE THAT ACTS ON THE COARSE ADJUSTMENT)
FIRST QUALITY MEDICAL OPTICS
16mm OBJECTIVE (10X) N.A. 0.27
4mm OBJECTIVE (44X) N.A. 0.66
10X HUYGHENIAN OCULAR
ELONGATED BASE TO PROTECT OBJECTIVES
SAFETY MOUNTING OF MIRROR
DISC DIAPHRAGM LIGHT CONTROL

Lower price $117.00
In quantities of 5 or more . . . . . . Each 105.30
TEN YEAR GUARANTEE   TRANSPORTATION INCLUDED
Or with substage illuminator instead of mirror.............Same price


Model GB2A

THE GRAF-APSCO COMPANY
5868 Broadway   Chicago 40, Ill.



STANDARD MICROSCOPE at SCHOOL BUDGET PRICE!

Dollar for Dollar, B&L Matches the Lowest Price; Feature for Feature, B&L is Miles Ahead!

- **STANDARD OPERATION** Separate coarse and fine adjustments . . . students learn correct microscopy from the start . . . nothing to unlearn later.
- **FULL STANDARD SIZE** Stable, sturdy for years of daily use. Students learn on a standard microscope, designed for comfortable, natural posture.
- **NEW FINE ADJUSTMENT** 1.5mm travel; 0.25mm tube travel per knob revolution . . . easier, more precise focus.
- **NEW 43X OBJECTIVE** Higher resolution (0.55 N.A.). Better image quality: flatter, distortion-free field; higher contrast.
- **NEW STAINLESS STEEL FOCUSING SLIDE** Less friction, less wear.
- **NEW PREFOCUSING GAGE** Faster, easier focus . . . saves instruction time, reduces damage to objectives and slides.

SERIES ST MICROSCOPES . . . STANDARD TEACHING Standard laboratory microscope stand; large stage; separate fine and coarse focusing; 10X eyepiece; double nosepiece; color-coded objectives: 10X, 0.25 N.A. and 43X, 0.55 N.A.; prefocusing gage; disc diaphragm; Optilume illuminator or mirror . . . . $125.

SERIES STA MICROSCOPES include intermediate models for use by students in college and nurses' training courses, and advanced models for instructors. Features include Rotosphere ball bearing nosepiece, laboratory-type objectives, and provision for mechanical stage and substage condenser. From $169.

See For Yourself in FREE DEMONSTRATION! Mail Coupon Today!

BAUSCH & LOMB
SINCE 1853

BAUSCH & LOMB OPTICAL CO.
78040 St. Paul St., Rochester 2, N. Y.

☐ Please schedule an obligation-free demonstration of new B&L ST Microscopes at my convenience.

☐ Send me informative folder D-1074.

NAME...
TITLE...
ADDRESS..
CITY......................... ZONE...... STATE........

TIME-LAPSE Photography

By JOHN B. REED

Dickinson County Community High School, Chapman, Kansas

This report was an entry in the 1957-58 STAR (Science Teacher Achievement Recognition) awards program conducted by NSTA and sponsored by the National Cancer Institute, U. S. Public Health Service.

FOUR years ago three physics students in our school were trying to decide on a science fair entry. One suggestion kept recurring at intervals, one which we all agreed impossible—*Time-Lapse Photography*. However, the more that we thought of time lapse the more attractive it became.

A quick look through various photographic supply house catalogues further convinced us that the cost of such apparatus was out of the question. Our school did have the following assets: a 16-mm movie camera, capable of single frame exposure, and three photoflood lamps. A check of the school library revealed nothing except that Disney studios had made a great deal of progress in the field.

From these meager beginnings developed an inexpensive time-lapse mechanism that has become the center of a science program which gives promise of continuing to enjoy that central position. The whole project has become of interest to both science and non-science majors, and much benefit has been derived from it.

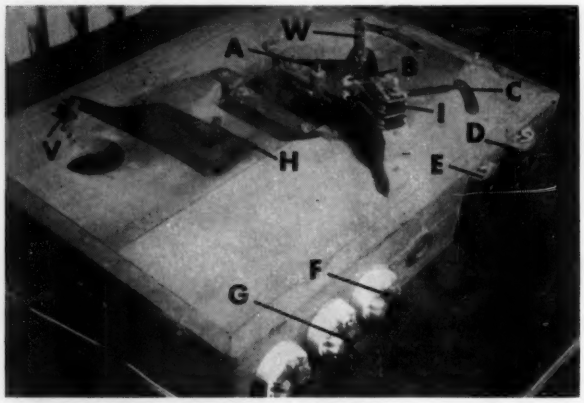
Time-lapse photography records events that occur over a considerable length of time and presents them in a short time interval. A time-lapse photography device must perform these functions:

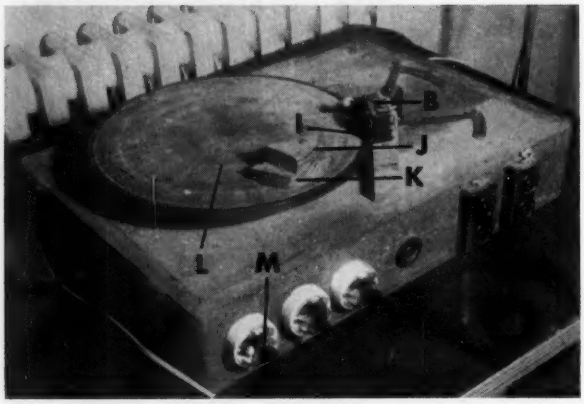
(1) Turn on the photographic lights.
(2) Actuate the camera to take a single exposure.
(3) Turn off the photographic lights.
(4) Release the camera (the camera then advances the film one frame).
(5) Time to the next interval.
(6) Repeat the entire sequence.

Using the materials we found around the school, and with some help from our shop people, we built an apparatus that accomplishes all of the listed functions. The total cost was $1.22 for two surplus microswitches.

Timing Control Unit

Our timer is a discarded two-speed phonograph motor and turntable. The turntable (Figure 2., L) was removed and given a separate spindle (H) on which to turn. This turntable is held against a drive spindle (A), turned out in our shop, so that the turntable will rotate once every minute with the speed control (C) of the motor set at 78 rpm and one revolution every





Figures 1 and 2. Timing control unit. (A) Power drive spindle (B) Light microswitch (C) Speed control (D) Light receptacle (E) Camera control receptacle (F) Camera test switch (G) Light test switch (H) Flotation turntable spindle (I) Camera microswitch (J) Light cam (K) Camera cam (L) Turntable (M) Off-on switch (V) Spring to press turntable against power drive spindle (W) Governor control.

2½ minutes with the speed at thirty-three rpm. Further variation can be obtained by changing the governor (W) on the motor. Two plywood cams (J, K) are bolted to the top of the turntable. Two micro switches (B, I) with rolling contact arms are mounted beside the turntable at the same height as the two respective plywood cams. One of these micro switches (B) controls the lights, and the other (I) closes the circuit to operate the camera for one single 16-mm exposure. As the cams come around with the turntable, one cam (J) is so formed and set so as to turn on the lights and hold them on.[1] After three seconds the camera control cam (K) closes the camera circuit, which takes the picture. As soon as the picture is taken, the lights are turned off by the light cam releasing the light microswitch, and the camera circuit is released in a like manner. The micro switches are in parallel with test switches (F, G) on the side of the timing box, and these are in series with the receptacles into which we plug our lights and the camera control unit.

Camera Control Unit

The camera control unit is a discarded electromagnetic speaker from which the cone has been removed. A selenium rectifier (O) is in series with a 110-volt AC line supplying the power to the electromagnet. When the power is applied to the electromagnet (P) by the closing of the camera control microswitch on the timing mechanism, a strong magnetic field develops in the core of the magnet. This magnetic field pulls down on a ⅜ inch steel bar (Q) which is used as a lever; and as this bar is pulled down about ¼ of an inch, it raises a brass finger (S) on the other end which in turn trips the camera. By placing the fulcrum (R) correctly, the length of travel of the tripping finger can be controlled. The height of the tripping finger is controlled by adjusting the two nuts (T) above and below it so that in its travel it moves the minimum necessary to trip the camera. A spring inside the camera which returns the camera trip to the normal position is of sufficient strength to raise the other end of the iron bar off of the electromagnet after energy is no longer supplied to that magnet. (Figures 3, 4, and 5.)

It is realized that schools interested in this type of project may not have the same materials which we used. However, the suggestions and methods are highly adaptable to any type of material or mechanism which will perform the six outlined functions. (Figures 6 and 7.)

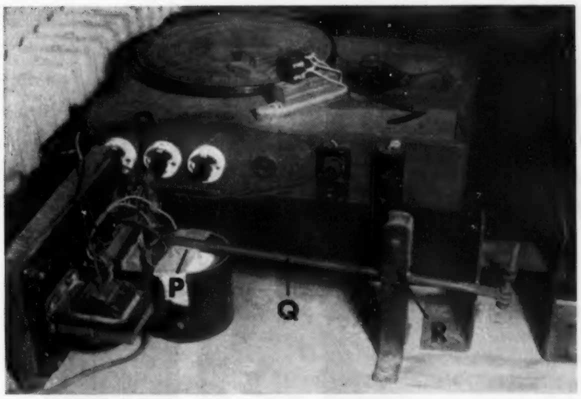
Methods of Use

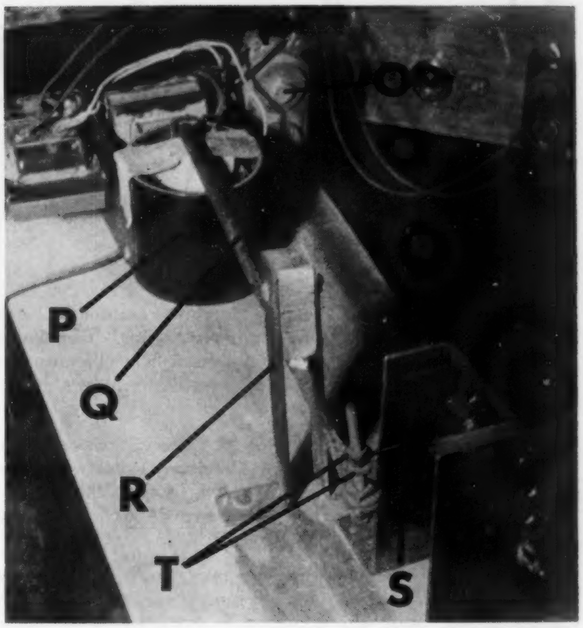
The time lapse, as we use it here, has done a great deal to integrate the science program; and while this in itself is a highly desirable result, we were surprised the appeal this project had for students not enrolled in science courses.

Since it is so simple, nearly every student can follow the process and understand the way it works, and can then see the results of the research in the finished film.[2] Furthermore we find

[1] The three-second time interval was planned so the photofloods could warm up to the correct color temperature for the exposure of tungsten-type color film.

[2] Since the operation is obvious, I feel this unit, even though it is crude in many respects, is of more interest to our students because they can see and understand the way it works. Better results could be obtained with an R/C decay circuit and relays. However, this type of time-lapse control would not have nearly the appeal to the students because of the technical knowledge that would be required to understand it.





Figures 3 and 4. Camera control unit. (O) Selenium rectifier (P) Electromagnet (Q) Lever arm (R) Lever fulcrum (S) Camera trip (T) Height adjustment nuts for camera trip.

other departments within the school are interested in participating in the production of these films and that the project has a highly desirable effect on those students *not* enrolled in science courses.

For example: The physics and biology classes are working on a project which will embody a time-lapse study of the life cycle of a bean plant. We plan to put sound on this film by the magnetic sound strip method, and we hope that the context of the narration will be supervised and performed by members from our speech department. Background music for the film will be furnished by students in the music department. Title cards, actual staging, involving color and design for suitable backgrounds, are within the province of our art department. The timing cycles, which will necessarily be variable for this film, will be computed and recommended by the mathematics classes. By using various non-science groups as suggested above, even the non-science student is given the opportunity to participate in a science project and contribute his own special talent in music, art, or speech, to the project. We feel that this contact with science for students not enrolled in a science curriculum is tremendously valuable to them.

Already uses for the time-lapse photography equipment have been suggested by the students. We will undertake them next year. One we hope will be crystal growth, which will be of interest to the physics, chemistry, and mathematics classes. Another is the growth of a thunder storm. A third project is the design and construction of a time-lapse 16-mm camera which will permit a synchronized speed light source. In each of these projects we hope to continue to utilize a production staff that includes as many different student talents as possible.

Other advantages of time-lapse photography, as we are using it here, include the necessity for the students in any phase of the production of these films to plan everything which applies to their own part in the production to the minute detail and also the necessity of working with each other to adapt their ideas to the continuity of the film. By inclusion of other departments we find that students who are not enrolled in science classes are given training in scientific method by working on these projects. Further, we feel that the science students, as well as the non-science students, are made aware of the position of science as a part of our society.

Figure 5. Camera in position showing relationship to tripping mechanism.

It's always "Exam Time" ....for science teachers

Every science teacher must maintain a constant vigil over the perfect balance of budget, technique and curriculum. Examination of newer techniques; examination of possible curriculum changes; examination of available budget for materials and supplies . . . yes, it's always "exam time" for science teachers!

In the matter of budgets for laboratory glassware, we have a few helpful suggestions. Examine our Diamond D glassware prices and those of our competitors! See the cost comparison on this page. Examine the Diamond D quality! Examine our new "FACTS" book available to all teachers!

When these examinations are over, you'll find that you can obtain more Diamond D glassware per budget dollar than you can with any other brand. And with Diamond D you'll get a lot more than just a passing grade. Diamond D is the mark of the highest quality . . . quality that begins with price and ends with performance. For additional information, write Doerr Glass Company, Dept. G, Vineland, New Jersey.

COMPARATIVE LIST PRICE CHART

ITEM	BRAND A	BRAND B	DOERR
PIPETTE (1 ml in 0.01) (Serological)	$1.31	$1.57	$0.90
PIPETTE (5 ml) (Volumetric)	1.19	1.36	0.79
PIPETTE (1 ml) (Ostwald)	1.14	1.28	0.81
CENTRIFUGE TUBE (15 ml)	1.28	1.28	0.69
FLASK (100 ml) (Glass Stoppered)	2.73	3.01	1.99
CYLINDER (100 ml)	2.71	2.94	1.48
SEPARATORY FUNNEL (250 ml) (Squibb)	6.22	6.56	5.21

NOTE: *All Diamond D glassware is sold exclusively through laboratory supply dealers and cannot be purchased direct. We will gladly send you the address of the nearest lab supply house that carries the Diamond D lines.*

Please send me FACTS BOOK

NAME__________ TITLE__________

COMPANY __________

STREET __________

CITY __________ STATE__________

DIAMOND "D" GLASSWARE

Quality Begins With Price And Ends With Performance

This apparatus, the benefit derived from time-lapse photography in a science program, and its integrating influence within the school have been used and tested here for four years to our satisfaction. The suggestions we have made here will prove helpful in the development of any use of time-lapse photography for schools which feel the need of: (1) An integrated science program, and (2) A method by which non-science students will be made aware of scientific methods.

In addition to the above, the whole project serves as a "springboard" to bring the views of both non-science and science students together.

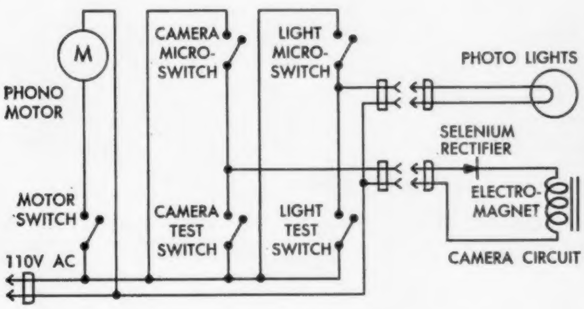


Figure 6. Schematic.

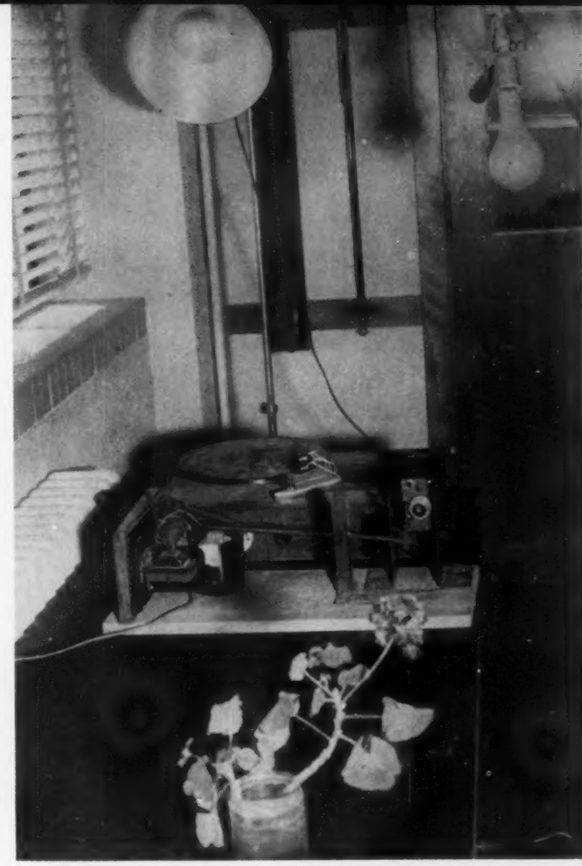
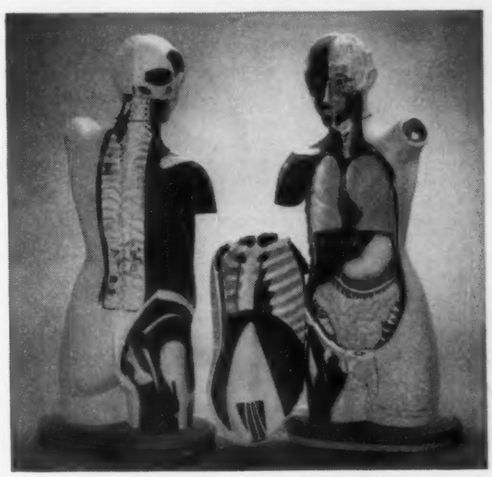


Figure 7. Entire time-lapse mechanism showing relationship of various components and subject of film in foreground.

BIOCRAFT

MODELS
CHARTS
SKELETONS
SLIDES
MOUNTS
SPECIMENS

When you select equipment for your classroom or laboratory, it is important to choose visual teaching appliances that have good appearance. After all, their effectiveness depends on eye appeal. But it is equally important to check on durability, since you will want teaching tools that last a long time. It is not impossible to obtain visual aids that combine both of these advantages.



DENOYER-GEPPERT
COMPANY
5245 RAVENSWOOD AVENUE CHICAGO 40

You Can Depend on the GENATRON

● *The MODERN Electrostatic Generator*

THE CAMBOSCO GENATRON serves not only for classical experiments in static electricity, but also for new and dramatic demonstrations that are not performable by any other means. It exemplifies a modern method of building up the tremendously high voltages required for atomic fission, for nuclear research, and for radiation therapy.

Entirely self-exciting the GENATRON cracks into action at the snap of the switch—whose only function is that of starting the motor drive. No auxiliary charging method is employed. Hence, despite an output measured in hundreds of thousands of volts, no hazard is involved, for the operator or for the observers.

An Output of 250,000 Volts—or More!

THE CAMBOSCO GENATRON is designed to deliver, in normal operation, a discharge of the order of 250,000 volts. That figure, a conservative rating, is based on many trials conducted under average conditions. With ideal conditions, a potential difference of 400,000 volts has been achieved.

Modern Design— Sturdy construction and ever-dependable performance distinguish the GENATRON from all electrostatic devices hitherto available for demonstration work in Physics. This powerful, high-potential source, reflecting the benefits of extensive experience in electrostatic engineering, has absolutely nothing but purpose in common with the old-fashioned static machine!

NO FRAGILE PARTS—Durability was a prime consideration in the design of the GENATRON which, with the exception of insulating members, is constructed entirely of metal.

The only part subject to deterioration is the charge-carrying belt, which is readily replaceable.

NO TRANSFER BODIES—In all conventional influence machines, whether of Holtz or Wimshurst type, electrical charges are collected and conveyed (from rotating plates to electrodes) by a system of "transfer bodies." Such bodies have always taken the form of metal brushes, rods, button disks or segments—each of which, inevitably, permits leakage of the very charge it is intended to carry, and thereby sharply limits the maximum output voltage.

It is a distinguishing difference of the GENATRON that electrical charges, conveyed by a non-metallic material, are established *directly upon the discharge terminal.* The attainable voltage accordingly depends only upon the geometry of that terminal and the dielectric strength of the medium by which it is surrounded.

Unique Features of the CamboscO Genatron

DISCHARGE TERMINAL Charges accumulate on, and discharge takes place from, the outer surface of a polished metal "sphere"—or, more accurately, an oblate spheroid.

The upper hemisphere is flattened at the pole to afford a horizontal support for such static accessories as must be insulated from ground. A built-in jack, at the center of that horizontal area, accepts a standard banana plug. Connections may thus be made to accessories located at a distance from the GENATRON.

CHARGE-CARRYING BELT To the terminal, charges are conveyed by an endless band of pure, live latex—a CamboscO development which has none of the shortcomings inherent in a belt with an overlap joint.

DISCHARGE BALL High voltage demonstrations often require a "spark gap" whose width can be varied without immobilizing either of the operator's hands.

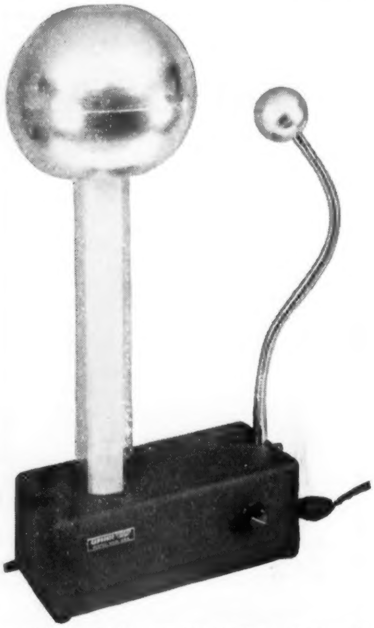
That problem is ingeniously solved in the GENATRON, by mounting the discharge ball on a flexible shaft, which maintains any shape into which it is bent. Thus the discharge ball may be positioned at any desired distance (over a sixteen-inch range) from the discharge terminal.

BASE... AND DRIVING MECHANISM Stability is assured by the massive, cast metal base—where deep sockets are provided for the flexible shaft which carries the discharge ball, and for the lucite cylinder which supports, and insulates, the discharge terminal.

The flat, top surface of the base, (electrically speaking), represents the ground plane. Actual connection to ground is made through a conveniently located Jack-in-Head Binding Post. The base of the Genatron encloses, and electrically shields, the entire driving mechanism.

PRINCIPAL DIMENSIONS The overall height of the GENATRON is 31 in. Diameters of Discharge Ball and Terminal are respectively, 3 in. and 10 in. The base measures 5¼ x 7 x 14 in.

GENATRON, WITH MOTOR DRIVE
Operates on 110-volt A.C. or 110-volt D.C. Includes: Discharge Terminal, Lucite Insulating Cylinder, Latex Charge-Carrying Belt, Discharge Ball with Flexible Shaft, Accessory and Ground Jacks, Cast Metal Base with built-in Motor Drive, Connecting Cord, Plug Switch, and Operating Instructions.
No. 61-705 .... **$98.75**



GENATRON, WITH SPEED CONTROL
Includes (in addition to equipment itemized under No. 61-705) built-in Rheostat, for demonstrations requiring less than maximum output.
No. 61-708 .... **$109.00**

No. 61-710 Endless Belt. Of pure latex. For replacement in No. 61-705 or No. 61-708 **$3.00**

CAMBOSCO SCIENTIFIC COMPANY

37 ANTWERP ST. • BRIGHTON STATION • BOSTON, MASS.

NSTA Activities

STAR '60

Seventy-five thousand science teachers now have full information on NSTA's STAR '60 awards program. With a top award of $1000 (and 55 others ranging from $500 to $100), competition is expected to be keen and productive. It is hoped there will be a good number of entries representing science teacher-scientist collaboration. Ideas for entries should be developed now; they should be classroom tested, refined, and reported not later than December 15, 1959. Entry forms and other STAR-related materials are available from NSTA headquarters. The program is supported by a grant from the U. S. National Cancer Institute.

Convention Schedule

For those who like to plan ahead, here is NSTA's convention schedule for the next four years.

8th, March 29-April 2, 1960; Kansas City, Mo.
9th, March 26-March 30, 1961; Chicago, Ill.
10th, March 25-29, 1962; California.
11th, March 31-April 4, 1963, Philadelphia, Penna.

The Kansas City committee has already held two planning sessions, and the Chicago committee will be named and hard at work by next November. Any invitations for 1964 should be sent to NSTA headquarters; a selection will likely be made at the Board of Directors meeting this summer.

1959 Summer Meeting

Details of the annual summer meeting of NSTA are being worked out under the chairmanship of Norman R. D. Jones. He has promised full program information for the May issue of *TST*. Meanwhile, you may want to know or have the following information to help you in your planning:

—Our meeting will be held July 1 in the YMCA, 16th and Locust Streets, St. Louis, Mo.
—There will be a general session from 9 to 10 a.m.
—There will be concurrent sessions for elementary science, junior high school science, the biological sciences, and the physical sciences from 10 a.m. to noon.
—The luncheon is scheduled from noon to 2 p.m., and tickets are priced at $2.50.

Nearby hotels are the Jefferson and the DeSoto (see current issues of the NEA *Journal* for hotel reservation forms). The business meetings of the NSTA Board of Directors (July 1-3) will be held in the Forest Park Hotel.

Dictionary of Education

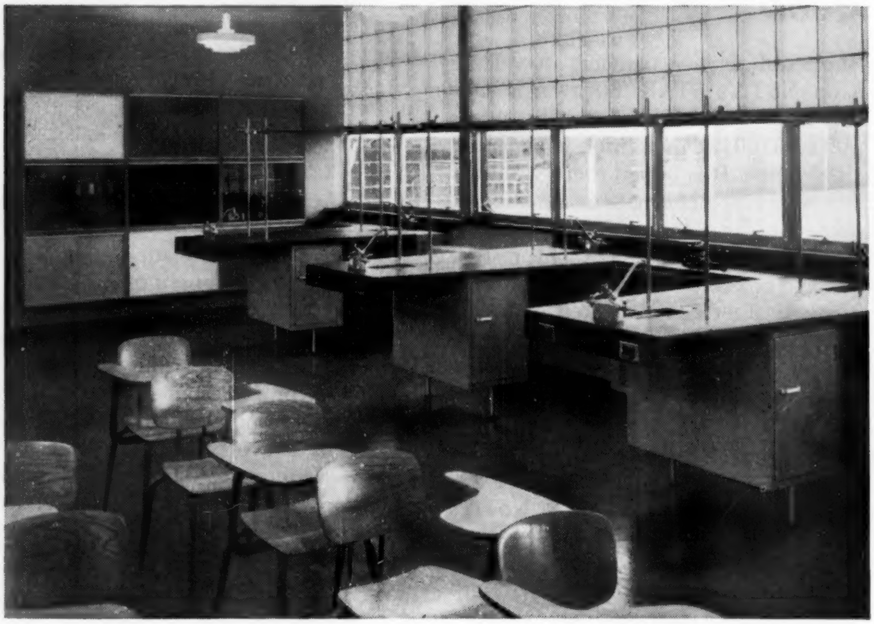
Many of you will want copies of the new, second edition of the *Dictionary of Education* (McGraw-Hill Book Co., Inc., New York City), prepared under the auspices of Phi Delta Kappa with Carter V. Good, University of Cincinnati, as editor. NSTA's contribution to its preparation dealt with science education and was coordinated by S. Ralph Powers (Emeritus), Columbia University, aided by the following committee: Kenneth E. Anderson, University of Kansas; Thomas J. Blisard, Newark (N. J.) College of Engineering; Clarence H. Boeck, University of Minnesota; Robert H. Carleton, NSTA.

In addition, the following also helped on this project: Palmer Johnson, University of Minnesota; Abraham Raskin, Hunter College; Herbert A. Smith, University of Kansas; Robert Stollberg, San Francisco State College; and Donald W. Stotler, Portland, Oregon, Public Schools.

NDEA

The National Defense Education Act of 1958 continues to be top education news of the day. Over 80,000 copies of NSTA's *Action for Science Under NDEA* have been distributed. As of March 25, 24 State plans had been approved by the U. S. Office of Education and funds under the Act were being channeled to various State departments of education. The 86th Congress has approved a supplemental appropriation of $32 million. Thus it should not be long before federal support is available to local school systems for *local projects which have been approved by their respective State education agencies.* The Council of Chief State School officers has a task force at work on development of a "purchasing guide" for science facilities. NSTA will attempt to keep abreast of such developments and relay the information to readers of *TST* through this column.

Maximum-use School Laboratories,
PERIMETER-PLANNED WITH UNAFLEX



Sjöström originated Perimeter Planning to give "every hour of every day" use of school laboratory facilities. The concept began with the UNAFLEX Perimeter Table and caught on immediately. The reason: It saves space and money . . . is easily adapted to new or existing facilities . . . is extremely efficient . . . inspires students and teachers.

The "Perimeter Planning" concept and thought-provoking laboratory furnishing ideas are presented by Sjöström in a colorful booklet. Write for descriptive literature.

SJÖSTRÖM USA

JOHN E. SJÖSTRÖM COMPANY, INC., 1717 N. TENTH ST., PHILADELPHIA 22, PA.

Designers and Manufacturers of UNAFLEX Laboratory Furniture

FSA Activities

Administrative Committee

The Future Scientists of America Foundation Administrative Committee is responsible for designing and developing programs of materials and services for science teachers. Two meetings are held in Washington, D. C., each year. The May meeting is held jointly with representatives from industry to study new project proposals, to plan the program of activities for the year, and to make the necessary budgetary allocations. An October meeting is held to identify services and materials needed by science teachers and to evaluate progress made on the various aspects of the program.

Administrative Committee members serve for a period of three years. Two members retire from the committee each year, thus permitting each NSTA president two appointees.

FSAF Committee members for 1958-59 from the NSTA Executive Committee are: *President,* Dr. Herbert A. Smith, University of Kansas, Lawrence; *President-elect,* Dr. Donald G. Decker, Colorado State College, Greeley; *Treasurer,* Dr. Robert T. Lagemann, Vanderbilt University, Nashville, Tennessee; and *Executive Secretary,* Robert H. Carleton, NSTA Headquarters.

The appointed members and date of retirement (in parentheses) are: Dorothy Tryon, Redford High School, Detroit, Michigan (1961); Dr. Harold Cassidy, Yale University, New Haven, Connecticut (1961); Dr. Philip G. Johnson, Cornell University, Ithaca, New York (1960); Dr. Zachariah Subarsky, Bronx High School of Science, New York City (1960); Dr. Samuel Meyer, College of Pacific, Stockton, California (1959); and Dr. Stanley E. Williamson, *Chairman,* Oregon State College, Corvallis (1959).

Annual Spring Meeting

The spring meeting of FSAF Administrative Committee will be held in Washington, D. C., May 8 and 9. A special meeting has been planned, on May 8, for representatives of FSAF sponsors and others interested in the activities of the Foundation. This program will provide reports as follows:

A Review of FSAF Activities—Dr. Stanley Williamson.

The On-the-Job Research Program—Dr. Philip Johnson.

High School On-the-Job Research Experiences—Mr. Robert Silber, Evansville, Ind., assisted by high school students.

Industry and the FSAF Program—A representative from Industry.

New Projects and Recommendations—General Planning Session.

The Administrative Committee, on May 9, will meet to plan the 1959-60 program and to determine budget needs for the year. The committee encourages you to submit ideas for FSAF activities which you believe would be valuable to classroom teachers.

Features of the 1958-59 Program

Thus far in 1958-59, the following publications and other activities have been completed:

Encouraging Future Scientists: Keys to Careers—5th edition; 25,000 copies to NSTA members and key science teachers.

Careers in Science Teaching—completely revised; 35,000 copies to NSTA members and key science teachers.

Ideas for Student Science Projects—suggestions for student science projects.

Science for the Academically Talented—report of work conference held in cooperation with NEA's project on the Academically Talented Student.

Tomorrow's Scientists—publication for high school science students; 30,000 subscribers.

Registry of U. S. Science and Mathematics Teachers—name list of 120,000 high school teachers of science and mathematics; made possible by a grant of $11,900 from the National Science Foundation and a supplementary grant of $3500 from FSAF.

Science in the Junior High School—report of the 1958 West Coast Summer Conference for Science Teachers.

On-the-Job Research—continued testing of idea for modest grants to enable secondary teachers and their students to have science research experiences. Twelve FSAF grants have been made to date.

Youth Science Activities—exploratory studies are under way looking toward a program of increased participation for youth who are potential "Future Scientists of America."

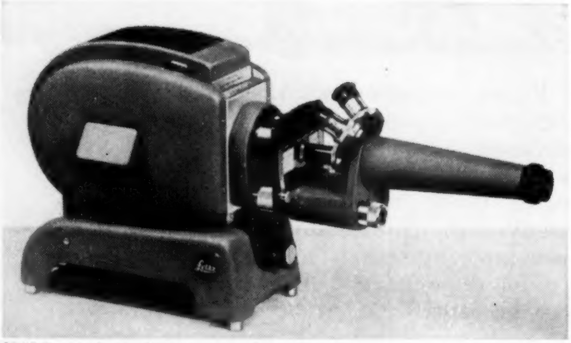
Leitz **first in precision optics**

PRADO
MICROPROJECTOR

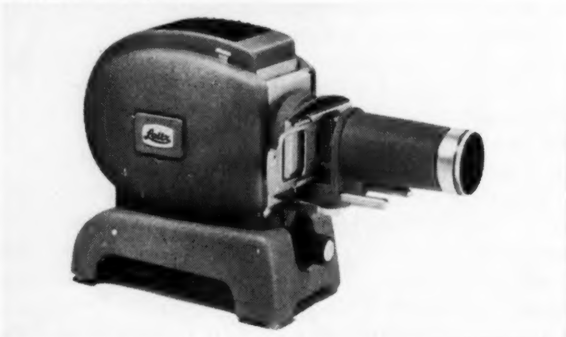
The extreme brilliance, clarity and definition in screen images from the well-known PRADO make it readily convertible from standard 2"x2" (Model 500) or 2¾"x2¾" (Model 66) slide projector to microprojector.

This portable unit may be carried easily from room to room and used wherever there is an electrical outlet. Light from the 500-watt lamp, projected through aspheric condensers in the blower-cooled PRADO, gives an image quality ideal for use in classroom or conference room.

For microprojection, the special microattachment simply slides onto the power-condenser housing. The attachment provides an object stage and adjustable condenser lens with helical focusing. A similar attachment is available which allows the stage to be placed in a horizontal position to accommodate wet mounts. The revolving nosepiece holds three objectives: 3.5x, 10x, and 25x. The high power objective is equipped with a spring-loaded mount.



PRADO, as microprojector



PRADO, as standard slide projector

20257

A reputation for integrity and a tradition of service have led thousands of scientific workers to bring their optical problems to Leitz. If you have problems in this field, why not let us help you with them?

See your Leitz dealer and examine these Leitz instruments soon. Write for information.

E. LEITZ, INC., Dept. ST-4
468 Fourth Avenue, New York 16, N. Y.

Please send me the Leitz_______________brochure.

NAME_______________

STREET_______________

CITY_______________ZONE_______STATE_______

E. LEITZ, INC., 468 FOURTH AVENUE, NEW YORK 16, N. Y.
Distributors of the world-famous products of
Ernst Leitz G. m. b. H., Wetzlar, Germany—Ernst Leitz Canada Ltd.
LEICA CAMERAS · LENSES · MICROSCOPES · BINOCULARS

SCIENCE TEACHING MATERIALS

Prepared by NSTA Teaching Materials Review Committee
Dr. Robert A. Bullington, Chairman
Northern Illinois University, Dekalb

BOOK BRIEFS

SCIENCE ALBUM. Gerald M. Straight. 319p. $4.75. Hart Publishing Company, Inc., 74 Fifth Ave., New York 11, N. Y. 1958.

A resource book. Includes brief biographies of great men of science, science experiments, facts, humor. Has sections covering the atom, rockets, solar system, animals of the past, and many others. Ends with science quizzes. Suitable for upper elementary and junior high students. Authoritative, well written. Illustrated.

ELEMENTS OF THE UNIVERSE. Glenn T. Seaborg and Evans G. Valens. 253p. $3.95. E. P. Dutton and Co., Inc., 300 Fourth Ave., New York 10, N. Y. 1958.

This book for teen-agers is the outgrowth of a series of television films featuring Dr. Seaborg. Built around the unifying theme of the periodic table, the science of chemistry is presented in a manner which will excite the curiosity, stimulate the imagination, and inspire the youthful audience for which it was especially written. It will prove absorbing reading for the liberal education of adult laymen. The book conveys the thrill and excitement of scientific discovery together with the satisfying logic of the science. A wealth of photographs, charts, and diagrams are well integrated into the text. Many guest scientists vividly describe their own discoveries and present special facets of the science.

THE AMERICAN HIGH SCHOOL TODAY. James B. Conant. McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N. Y. 1959.

The former President of Harvard University expresses his conviction that our system of public high schools is capable of meeting the educational needs of the nation's youth. He calls upon all teachers, parents, school boards, and others for renewed efforts to improve the school along the lines of 21 specific recommendations. These recommendations include strong counseling systems with good articulation between the upper and lower levels, individualized programs, ability grouping, programs for the academically talented, strong basic science programs for all, and advanced courses for those of greater ability and interest.

WEATHER IN YOUR LIFE. Irving Adler. 126p. $3. The John Day Company, 210 Madison Ave., New York 16, N. Y. 1959.

Easy to read explanation of factors producing and affecting weather. Informative, scientifically accurate, and a good reference for upper elementary students through college and adult groups.

THE TAPE RECORDER IN THE CLASSROOM. Julia Mellenbruch. 67p. $2. Visual Instruction Bureau, Division of Extension, University of Texas, Austin 12, Texas. 1959.

Science teachers can find many uses for the tape recorder. This excellent booklet gives all the needed details for the use of this instructional aid.

MOON TRIP. William Nephew and Michael Chester. 63p. $2.50. G. P. Putnam's Sons, 210 Madison Ave., New York 16, N. Y. 1958.

A well-written, authoritative book on space travel with introduction, problems of space travel, description of the moon, and the problem of return. Covers a complete moon trip in an interesting style with sound scientific principles. For junior high school students. Illustrated.

FIGHTER PLANES THAT MADE HISTORY. David C. Cooke. 72p. $2.50. G. P. Putnam's Sons, 210 Madison Ave., New York 16, N. Y. 1958.

An interesting, informative book on the history of fighter planes. Covers the historic fighter planes since 1915 and proposed planes of the future. Full of facts and figures for the aviation-minded junior high school student. Well illustrated.

ALUMINUM THE MIRACLE METAL. C. B. Colby. 48p. $2. Coward-McCann, Inc., 210 Madison Ave., New York 16, N. Y. 1958.

Photographs and descriptions portray the story of aluminum. Mining, methods of processing ore, smelting, fabrication, and uses of aluminum are illustrated and interestingly related. Gives photographic-historical introduction. Recommended for middle and upper grades.

PROFESSIONAL READING

"Mathematics and Science." by Elmo Pack. *The Clearing House,* 33:13. September 1958. Arguments for integration of mathematics and science.

"The Earth Our Greatest Magnet." By Grace E. Koerner. *Grade Teacher,* 76:22. April 1959. How the laws of magnets, types of magnets, electrostatics, and the electroscope apply to the elementary science classroom.

"Air and Outer Space." By Franklyn M. Branley. *Grade Teacher,* 76:39. April 1959. Suggestions for teaching about air and outer space.

"A Unit on Color." By Mary Nygaard Peterson. *Grade Teacher,* 76:47. April 1959. Covers the scientific explanation of what color is, the structure of the eye, and the camera. A list of things to do is provided.

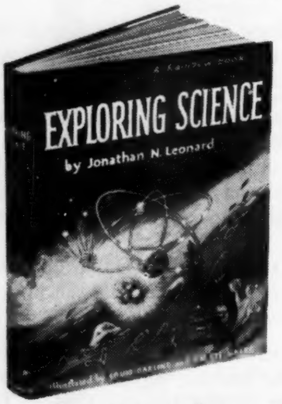
"Refraction." By Verne N. Rockcastle. *The Instructor,* 68:21. March 1959. Activities for teaching about light waves.

"Weather at the Primary Level." By Ann Eddy Hatch. *The Instructor,* 68:62. March 1959. A unit on weather for grades 1, 2, or 3. Objectives, experiments, a bulletin board, a display, and a series of weather broadcasts are described.

"Research in Teaching College Science." By Vaden W. Miles and W. C. Van Deventer. *College and University Bulletin,* 11: No. 8, March 1, 1959. Summary discussion and bibliography of 60 items.

EXPLORING SCIENCE

(A Rainbow Book)



A brilliantly written, comprehensive survey of the world of science and man's scientific achievements

by Jonathan N. Leonard

Science Editor of *Time* magazine

With 140 illustrations, over 70 in color, by Louis Darling and I. N. Steinberg

$4.95 • Ages 10 up

Write for complete list of our science books

THE WORLD PUBLISHING COMPANY

2231 West 110th St., Cleveland 2, Ohio

APPARATUS and EQUIPMENT

THE WEATHERSCOPE. R. B. Cutler. The "Weatherscope" is an ingenious device, excellent for motivation and explanation of weather phenomena. Consists of a poster-type map of North America and a variety of colored symbols which adhere to the surface. Explains weather forecasting, permits students to better interpret station or area statistics, and helps students take an active, daily interest in plotting and forecasting the weather of North America. Acquaints students with the use of symbols and in following a proper method of analysis before making a prognostication. $5. 1958. Planoramics, 631 East First St., Boston 27, Mass.

BASIC KIT OF DINOSAURS. Kit for use in grades 4-6 containing a 125-page paper booklet about dinosaurs, five genuine fossils, and two six-inch replicas of dinosaurs. The booklet contains detailed information about dinosaurs, a pronouncing dictionary, a list of North American museums, and selected references. Very useful in developing an interest in the past. Kit developed by Stanley Brown and Barbara Brown. $2.95. 1958. Harvey House Publishers, Irvington-on-Hudson, New York, N. Y.

GRAPHIC CHEMICAL PREDICTOR. A convenient device consisting of a plastic dial for the use of chemistry students studying ionic equations which involve oxidation and reduction. Not only can the device be used to balance some 10,000 different equations, but also, through the use of assigned oxidation-reduction potentials the Predictor may be used to predict whether or not a given chemical reaction will take place. Price $1.95 including instructions. Graphic Calculator Company, Department DH, 633 Plymouth Court, Chicago 5, Ill.

AUDIO-VISUAL AIDS

HOW GREEN PLANTS MAKE AND USE FOOD. Designed for senior high biology, this film will be useful in any course where photosynthesis is studied. Excellent stimulus to further study. Includes animation that illustrates processes and excellent photomicrography of plant tissues. 11 min. Color $110, B&W $60. 1958. Coronet Films, Coronet Building, Chicago 1, Ill.

LIFE LONG AGO. Film series depicts the fossil story on a level suitable for fifth through ninth grade students. It is interesting, accurate, and informative, especially when used with the 40-page teaching guide. Contains many excellent color photographs of museum specimens. Titles of the six parts are: Up Through the Coal Age, When Reptiles Ruled the Earth, Mammals Inherit the World, Hunting Fossils, Stories that Fossils Tell, and How We Know About Life Long Ago. Set of 6 film strips, totaling 252 frames. Color. Set, $32.40, with teaching guide. 1958. Produced by Row, Peterson and Company, Evanston, Ill., in cooperation with the Chicago Museum of Natural History. Distributed by Society for Visual Education, Inc., 1345 Diversey Parkway, Chicago 14, Ill.

Readers' Column . . . from page 149

their over-all development in science over a period of years; let us examine the way they handle data, the way they approach problems, the way they ask questions. If from time to time they disappoint us by their performance on a standardized test, let us examine the validity of the test along with our examination of our teaching methods and curriculum structure. And for heaven's sake, let's not teach for the sake of scoring well on a standardized test, for to do so is a monstrous distortion of science and science teaching.

RANDOLPH R. BROWN
35 Clarke Street
Lexington 73, Mass.

Biology Texts

There is a tendency among teachers of all ages to correct the errors of the past as they are uncovered, regardless of minuteness or enormity, irrevelance or importance. This is good. There is an error in biology and general science teaching which is both minute and irrevelant, but which none the less exists and persists. I wish to offer to all present and future teachers, authors, and publishers a correction. *In reviewing six high school biology texts,* I found five of the six credit the name *cell,* assigned by Robert Hooke in his *Micrographia* to the empty chambers observed in thinly sliced cork, as being derived from their resemblance to the rows of cells in a monastery. My reading of both modern quotations as well as a microfilm of an original edition show that this is not true, and I offer the following quotation in evidence:

> ". . . I could exceedingly plainly perceive it to be all perforated and porous, much like a Honey-comb, but that the pores of it were not regular, yet it was not unlike a Honey-comb . . . ."

ROBERT A. HODGE
Biology Instructor
James Monroe High School
Fredericksburg, Virginia

SCIENCE TEACHERS, along with other classroom teachers, will be interested in the following paragraph taken from the 1959 Resolutions adopted by the American Association of School Administrators, NEA, at their Atlantic City convention on February 18.

> "Because of the important contributions made by classroom teachers to improvement of schools through professional organizations, we recommend establishment of appropriate policies of releasing, without loss of pay, teachers who are invited to serve as participants in conferences and conventions of major professional organizations at local, state, and national levels."

WHERE PHYSICS TEACHING STANDARDS ARE THE HIGHEST

BASIC PHYSICS

by Dr. Alexander Efron, Stuyvesant High School, N. Y. C.

Most modern physics text for effective instruction . . . greatest student interest.

A new, thoroughly modern text worthy of the space age with a new teaching approach offering an enriched course in an intermediate physics for high school and junior college students. Adopted by school after school where teaching standards are the highest. Here are just a few.

Noble & Greenough School, *Dedham, Mass.;* Francis W. Parker School, *Chicago, Ill.;* Sequoia Union High School District, *Redwood City, Calif.;* Madera Union High School, *Madera, California;* Elkhart High School, *Elkhart, Indiana;* Fieldston School, *Riverdale, New York;* School District of Bethlehem, *Pennsylvania;* School District of Webster Grove, *Missouri;* San Leandro Unified School District, *San Leandro, California;* Midland School, *Los Olivos, California;* Blanche Ely High School, *Pompano Beach, Florida;* Monmouth High School, *Monmouth, Illinois;* West High School, *Rockford, Illinois;* Community High School, *West Chicago, Illinois;* Ames Community School District, *Ames, Iowa;* Friends School, *Baltimore, Maryland;* Braintree High School, *Braintree, Massachusetts;* Mendon High School, *Mendon, Massachusetts;* Roxbury Latin School, *Roxbury, Massachusetts;* Michigan Lutheran Seminary, *Saginaw, Michigan;* Fulton High School, *Fulton, New York;* Davis High School, *Mt. Vernon, New York;* New York Trade School, *New York City;* Stuyvesant High School, *New York City;* Central High School, *Syracuse, New York;* Cleveland Heights City School District, *Cleveland Heights, Ohio;* Urbana High School, *Urbana, Ohio;* Milford High School, *Milford, Connecticut;* Orville H. Platt High School & Francis T. Maloney High School, *Meriden, Conn.;* Austin High School, *Chicago, Ill.;* Thomas A. Edison Voc. High School, *Jamaica, N. Y.;* West Point Public Schools, *West Point, Ga.;* West Morris Regional H. S., *Morris County, N. J.*

#195, 2 vols. in single cloth binding, 274 pps., 800 illustrations, $7.60 list.

Quickest, Easiest way to teach Electricity, Electronics

BASIC ELECTRICITY • BASIC ELECTRONICS

by Van Valkenburgh, Nooger & Neville, Inc.

THE FABULOUS "PICTURE BOOK" COURSES DERIVED FROM THE NAVY'S TRAINING PROGRAM!

This is the fabulous "common-core" training course so successfully used by the United States Navy! Over 25,000 Navy trainees have already mastered the basics of electricity and electronics this new "learn by pictures" way and now, for the first time, the same material is available to the civilian schools! Over 1,700 big "show how" drawings make every phase picture clear—these illustrations actually make up more than half the entire course!

BASIC ELECTRICITY #169, 5 vols. soft cover set, $10.00
#169-H, cloth bound all 5 vols. in single volume, $11.50

BASIC ELECTRONICS #170, 5 vols. soft cover set, $10.00
#170-H, cloth bound all 5 vols. in single volume, $11.50

Send for review copies on 30-day approval. At end of 30 days either remit price of book, or return it without cost.

SCHOOL DISCOUNTS APPLY **Dept. ST-4**

JOHN F. RIDER PUBLISHER, INC.
116 West 14th Street, New York 11, N. Y.

HECTOR REPORTS: NSTA has a limited supply (500 copies only) of *The American Economy: An Appraisal of Its Social Goals and the Impact of Science and Technology.* Sixteen major addresses at the Science-Economics Workshop at Sarah Lawrence College, August 1958, co-sponsored by NSTA, the Joint Council on Economic Education, and the National Council for the Social Studies. 156p. $2.

Order this book directly from NSTA; please send payment with order. (This instruction is a temporary departure from the standard procedure of ordering NSTA publications from the Publications-Sales Section of NEA.)

Available Publications

Here are two new publications recently distributed to all NSTA members, free, but available in quantity orders.

1. *Action for Science under NDEA.* Report of an Association Conference on the National Defense Education Act of 1958. 22p. Quantity order, 15 cents each.
2. *Careers in Science Teaching.* A pictorial report of career opportunities from inside the professions. Revised Edition, 1958-9. Quantity order, 10 cents each.

A third publication just off the press is *Science for the Academically Talented Student in the Secondary School.* Report of the conference sponsored jointly by the National Education Association Project on the Academically Talented Student and the National Science Teachers Association. Offers suggestions as to content in science and methods in science for this group of students in grades 7-12. 64p. 60¢. Discount on quantity orders.

In-Service Institutes

Approximately 9,000 secondary school teachers of science and mathematics will benefit during the academic year 1959-60 from 182 National Science Foundation In-Service Institutes conducted by United States colleges and universities.

Institute meetings will be held outside regularly scheduled school hours—e.g., evenings, Saturdays, or late afternoons—so that teachers may attend while still teaching full time in their schools. A typical institute might meet once a week for two hours for the full academic year of about 30 weeks. Teachers participating in these institutes will receive financial support in the form of allowances at the rate of seven cents per mile for travel from their homes to the institutes. Those teachers granted support will not have to pay tuition and fees.

Participants will be chosen by the institutes, *not* by the National Science Foundation. *Requests for application forms and inquiries concerning specific courses offered should be addressed to the directors of the individual institutes,* a list of which may be obtained from NSF, Washington 25, D. C.

Index of Advertisers

Albert Teachers Agency 167
American Optical Company 172
Bausch & Lomb Optical Company 194
Bell Telephone Laboratories 190
Berkeley Enterprises, Inc. 163
Cambosco Scientific Company 200
Can-Pro Corporation 167
Central Scientific Company 183
Clay-Adams, Inc. 166
College Entrance Book Company, Inc. . . . . Cover II
Colorado, University of 177
Corning Glass Works 159
Denoyer-Geppert Company 199
Doerr Glass Company 198
Edmund Scientific Company 189
General Biological Supply House, Inc. 174
Globe Book Company 149
Graf-Apsco Company 193
Harcourt, Brace and Company . . . . Cover III
E. Leitz, Inc. 204
Ohaus Scale Corporation . . . . Cover IV
John F. Rider Publisher, Inc. 207
Row, Peterson and Company 174
Science Associates 188
Science Materials Center 157
Scott, Foresman and Company 177
Charles Scribner's Sons 162
John E. Sjostrom Company, Inc. 202
Stansi Scientific Company 178
Swift & Anderson, Inc. 145
Testa Manufacturing Company 175
Unitron Instrument Div., United Scientific Co. . 165, 184-5
D. Van Nostrand Company, Inc. 180
Warp Publishing Company 152
Franklin Watts, Inc. 160
W. M. Welch Scientific Company 146
Wilkens-Anderson Company 156
World Publishing Company 206

3 new editions this spring in the

HARCOURT, BRACE SCIENCE PROGRAM for JUNIOR AND SENIOR HIGH SCHOOLS

Under the General Editorship of Paul F. Brandwein

FOR JUNIOR HIGH SCHOOLS

The Science for Better Living Series: *Brandwein, Hollingworth, Beck, Burgess*

- **YOU AND YOUR WORLD** *(grade 7)*
- **YOU AND YOUR INHERITANCE** *(grade 8)*
- **YOU AND SCIENCE** *(grade 9)*
- **SCIENCE FOR BETTER LIVING: Complete Course**

Harbrace Science Filmstrips *Brandwein, Joseph*

FOR SENIOR HIGH SCHOOLS

EXPLORING BIOLOGY: The Science of Living Things *Ella Thea Smith*

YOUR BIOLOGY (for non-academic courses) *Smith, Lisonbee*

YOUR HEALTH AND SAFETY *Clemensen, Lawrence, Hoyman, LaPorte*

LIFE GOES ON: Second Edition (sex education) *Burnett, Clemensen, Hoyman*

THE PHYSICAL WORLD: A Course in Physical Science *Brinckerhoff, Cross, Watson, Brandwein*

EXPORING PHYSICS: New Edition *Brinckerhoff, Cross, Lazarus*

EXPLORING CHEMISTRY *Greenstone, Hollingworth (in preparation)*

• Accompanying program of correlated teaching aids: workbooks, tests, manuals, answer keys •

A SPECIAL BOOK FOR THE STUDENT

HOW TO DO AN EXPERIMENT *Goldstein*

BOOKS FOR THE TEACHER

The Teaching High School Science Series:

- **A BOOK OF METHODS** *Brandwein, Watson, Blackwood*
- **A SOURCEBOOK FOR THE BIOLOGICAL SCIENCES** *Morholt, Brandwein, Joseph*
- **A SOURCEBOOK FOR THE PHYSICAL SCIENCES** *Joseph, Morholt, Brandwein (in preparation)*

THE GIFTED STUDENT AS FUTURE SCIENTIST *Brandwein*

HARCOURT, BRACE AND COMPANY *New York 17*
Chicago 1
Pasadena 2

Harcourt, Brace & Co., School Text Promotion Division, 750 Third Avenue, New York 17, N. Y.

YOUR SCIENCE DEPARTMENT

deserves the very best

OHAUS PRODUCTS ARE SOLD BY LEADING LABORATORY SUPPLY DEALERS THROUGHOUT THE UNITED STATES AND CANADA